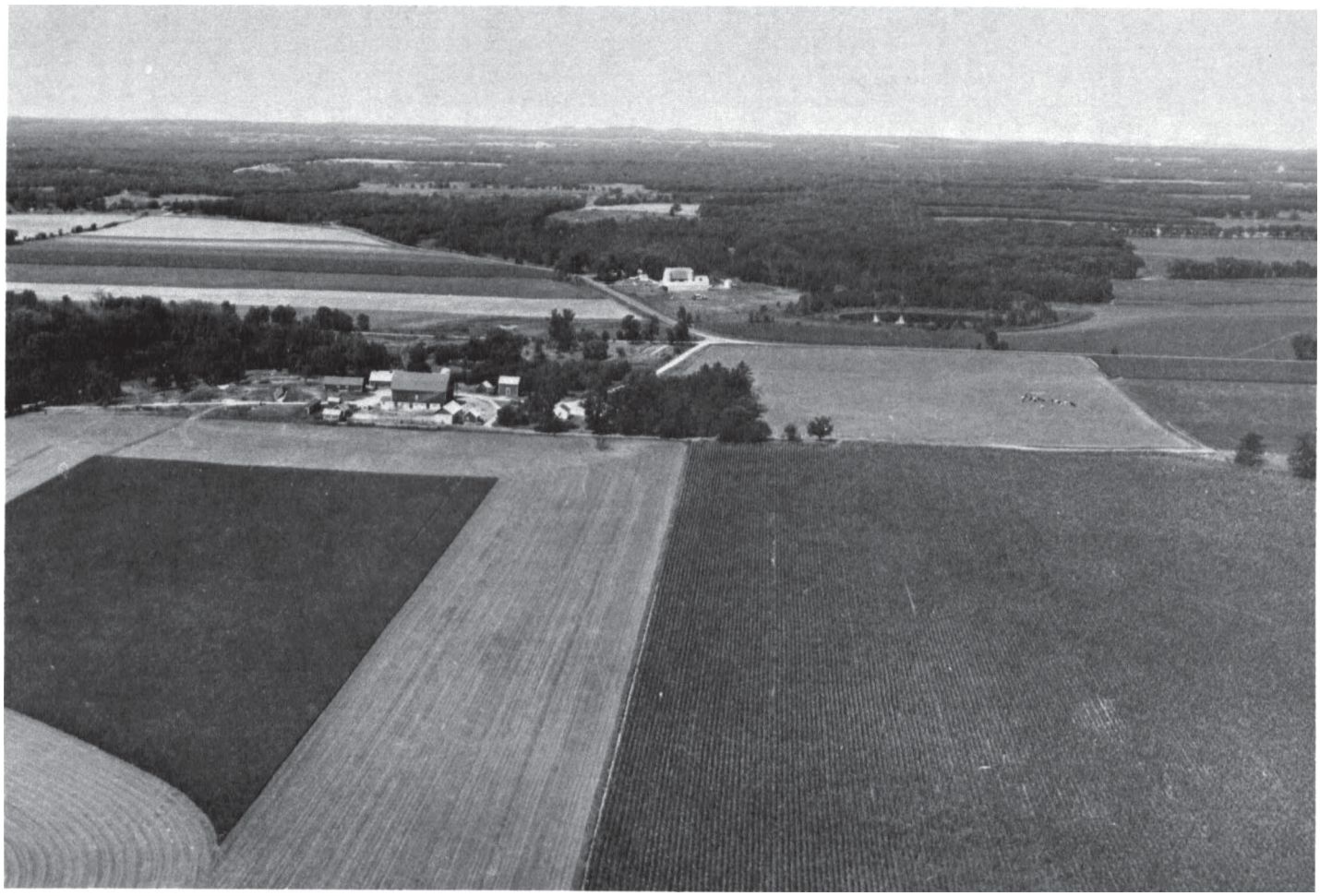
SOIL SURVEY OF

Marquette County, Wisconsin



United States Department of Agriculture
Soil Conservation Service
In cooperation with
The Research Division of the
College of Agriculture and Life Sciences
University of Wisconsin

Major fieldwork for this survey was done in the period 1946–63. Soil names and descriptions were approved in 1969. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1963. This survey was made cooperatively by the Soil Conservation Service and the Research Division of the College of Agriculture and Life Sciences, University of Wisconsin. It is part of the technical assistance furnished to the Marquette County Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, U.S. Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied to managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils in Marquette County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described. It also shows the capability unit, woodland group, recreation group, and wildlife group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units and other interpretive groups.

Foresters and others can refer to the section "Woodland Uses of the Soils" where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Marquette County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "General Nature of the County."

Cover: A typical Marquette County farmstead. The nearly level to gently sloping soils are Briggsville silt loam, Delton fine sandy loam, and Mundelein silt loam.

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SOIL SURVEY OF MARQUETTE COUNTY, WISCONSIN

BY KEITH O. SCHMUDE, SOIL CONSERVATION SERVICE

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE RESEARCH DIVISION OF THE COLLEGE OF AGRICULTURE AND LIFE SCIENCES, UNIVERSITY OF WISCONSIN

MARQUETTE COUNTY is in the south-central part of Wisconsin (fig. 1). Its land area is about 291,200 acres, or 455 square miles. About 6,000 acres is water. The county is about 20 miles long and 22 miles wide. It has 14 civil townships. Montello, the county seat, is in the east-central part of the county.

Farming is the most important enterprise, but there are 12 manufacturing plants in the county. Corn is the most widely grown crop, and oats also are important. A considerable number of hogs, pigs, cattle, and calves are raised.

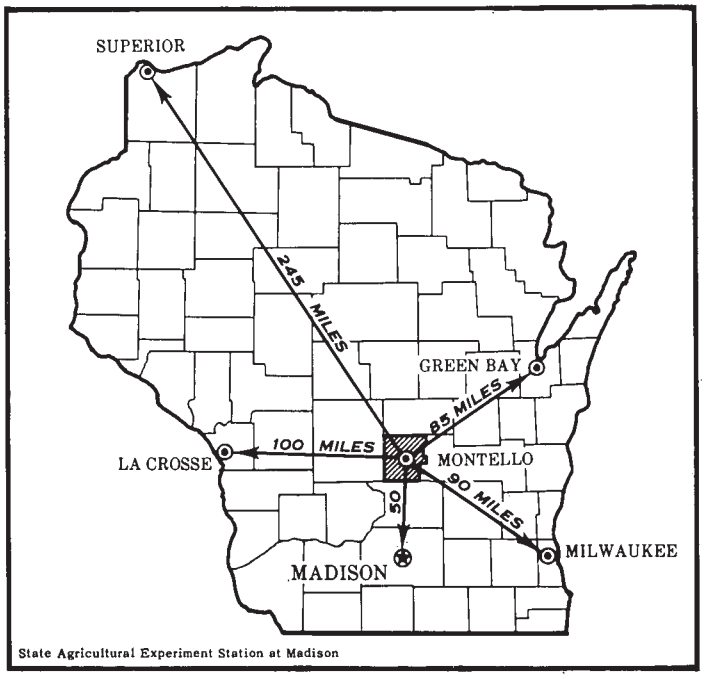

Figure 1.—Location of Marquette County in Wisconsin.

Physiography, Relief, and Drainage

Marquette County lies within the glaciated part of Wisconsin on the southeastern fringe of the Central Sandy Plains. The topography of the county varies because there are numerous recessional moraines, pitted plains, outwash terraces, kames, eskers, and lacustrine basins. Most of the soils are underlain by many feet of glacial drift.

The southeastern part of the county is typified by long drumlin-like ridges that have an east-west orientation. Lapeer and Pardeevile soils are dominant on these ridges. The southwestern and west-central part of the county has a relief of steep, hilly moraines adjacent to level to undulating lacustrine basins. This part of the county has a complex soil pattern. The northwestern part of the county is characterized by well-drained upland soils on irregular shaped hills and ridges and deeply pitted outwash terraces. The north-central and northeastern part of the county is dominantly a complex pattern of wet and well-drained soils in level lacustrine basins and on gently undulating outwash terraces. Some isolated hills and ridges occur througout this area. The central and east-central part of the county is dominantly gently sloping to sloping soils on outwash benches. Some isolated lacustrine basins and steep-sided pits are within this area.

About one-third of the land area of the county consists of wetlands. They are somewhat poorly drained, poorly drained, and very poorly drained areas of both mineral and organic soils. The county is drained by somewhat irregular channeled streams that flow into and out of lakes and have a limited number of relatively short tributaries. Many of the lakes are shallow and are formed by dams along rivers and streams. Other smaller lakes occur at random throughout the county. They are in natural depressions that are remnants of glaciation. The Fox River is the major river in the county. It serves as an outlet for all other streams draining Marquette County, including such major streams as the Montello, Mecan, Grand, and White Rivers. Many smaller creeks and streams also flow into these rivers and their tributaries.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Marquette County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils

they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey (*3*).[1]

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Boyer and Casco, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Boyer loamy fine sand, 2 to 6 percent slopes, is one of several phases within the Boyer series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soils of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Boyer-Oshtemo loamy sands, 2 to 6 percent slopes, is an example.

[1] Italic numbers in parentheses refer to Literature Cited, p. 90.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Steep sandy land is a land type in this county.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Marquette County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in Marquette County are discussed in the following pages.

1. Lapeer-Pardeeville-Metea association

Deep, well-drained, moderately permeable and moderately rapidly permeable soils that have a sandy clay loam, sandy loam, and loamy sand subsoil over loamy glacial till

This association is mostly in the southeastern part of the county. It consists of gently sloping to steep soils on ridges and hills. These soils are well drained and are underlain by loamy glacial till.

This association makes up about 3 percent of the county. It consists of about 60 percent closely intermingled Lapeer and Pardeeville soils, 30 percent Metea soils, and 10 percent Boyer, Gotham, and Fox soils (fig. 2).

The closely intermingled Lapeer and Pardeeville soils generally are on ridgetops and side slopes. They are fine sandy loam and sandy loam to a depth of about 24 to 36 inches and are underlain by sandy loam glacial till. The Metea soils are mostly on foot slopes. In some areas they are undulating, rolling, and hilly. Metea soils have a fine sandy loam or loamy fine sand surface layer up to 30 inches thick. They have a medium-textured subsoil about 20 inches thick that is underlain by sandy loam glacial till. In some areas they have a substratum of stratified silt and fine sand.

The native vegetation was mostly oak forest that had openings in grass. Much of the acreage has been cleared, and it is suited to cultivation where carefully managed and protected against soil blowing and erosion. The steeper soils are used mainly for pasture and as woodland. Water erosion and soil blowing are moderate hazards on some of the cleared soils.

2. Gotham-Mecan association

Deep, well-drained, moderately rapidly permeable and rapidly permeable soils that have a sandy loam and loamy fine sand subsoil over loamy glacial till and sandy outwash

This association is distributed throughout the county, except in the central part. It occupies hills, ridges, foot slopes, and lower lying areas.

This association makes up about 6 percent of the county. It consists of about 50 percent Gotham soils, 30 percent Mecan soils, and 20 percent Delton, Oshtemo, and other minor soils.

Figure 2.—Landscape in the Lapeer-Pardeeville-Metea association.

The Mecan soils are on the hills and ridges. They are moderately coarse, and the subsoil extends to a depth of about 45 inches. Below this is sandy loam to loamy sand glacial till. The Gotham soils are on foot slopes and in lower lying areas. They are moderately coarse to coarse and have a well-drained subsoil that is underlain by about 20 to 30 inches of sandy outwash.

The native vegetation was mostly oak. Much of this association has been cleared, and it is suited to cultivation where carefully managed and protected against soil blowing and water erosion. The steeper soils are used mainly for pasture and as woodland. Soil blowing and water erosion are moderate hazards on much of the cleared acreage. Conservation of water and organic matter is important because many of the soils have low available water capacity.

3. *Plainfield-Gotham association*

Deep, excessively drained and well-drained, very rapidly permeable and rapidly permeable soils that have a sand substratum or a loamy fine sand subsoil over sandy outwash

This is the most extensive soil association in the county. It is distributed mainly in the north and central part of the county.

This association makes up about 30 percent of the county. It consists of about 35 percent Plainfield soils, 30 percent Gotham soils, and 35 percent Wyocena, Boyer, Oshtemo, and other minor soils.

The Plainfield soils are coarse textured and excessively drained. They formed in acid outwash sand. The Gotham soils have a moderately coarse to coarse subsoil that is underlain by outwash sand at a depth of about 20 to 30 inches. In the north-central part of the county the Gotham and Plainfield soils are mostly nearly level to gently sloping. In the northwestern and west-central parts of the county, the soils are steep and are on hills and ridges.

The vegetation was mainly a sparse cover of black oak. Some of the association has been cleared and is used for crops. Cropped soils must be carefully managed and protected against soil blowing and water erosion. The steeper soils are used mainly for pasture and as woodland. Moderate soil blowing and water erosion occur in much of the cleared acreage. Conserving water and organic matter is important because the soils have low available water capacity.

4. *Delton-Briggsville-Mundelein association*

Deep, well-drained and somewhat poorly drained, slowly permeable and moderately slowly permeable soils that have a silty clay and silty clay loam subsoil over lake-laid silt, clay, or sand

This association is distributed mostly in the western part of the county, but small areas are in the northern, eastern, and southern parts. The soils are underlain by lake-laid silt and clay and silt and fine sand.

This association makes up about 15 percent of the county. It consists of about 15 percent Delton soils, 15 percent Briggsville soils, and 9 percent Mundelein soils. The remaining 61 percent of this association is made up of the Montello, Poygan, Mosel, Sisson, Colwood, Keowns, and other lake-laid soils.

The well-drained Briggsville, Delton, and Sisson soils range from nearly level to steep. The Briggsville soils have a moderately fine subsoil that extends to a depth of about 38 inches and is over lake-laid silt and clay. The Delton soils are coarse to a depth of about 30 inches and moderately coarse to a depth of 37 inches. Below this is lake-laid silt and clay. The somewhat poorly drained Mundelein soils have a medium-textured subsoil that extends to a depth of about 28 inches and is over silt loam and very fine sandy loam.

The native vegetation was mixed hardwoods, mostly oaks. Much of the association has been cleared and is suited to cultivation.

In some nearly level areas of the well drained and moderately well drained soils, surface drainage helps prevent temporary ponding. Some cleared areas of this association are moderately eroded by water.

5. *Granby-Tedrow-Moundville association*

Deep, poorly drained, somewhat poorly drained, and moderately well drained, rapidly permeable soils that have a loamy fine sand subsoil over sandy outwash

This association is distributed mostly in the northeastern, north-central, south-central, and eastern parts of the county. These soils formed in sandy outwash.

This association makes up about 10 percent of the county. It consists of about 50 percent Granby soils, 30 percent Tedrow soils, and 12 percent Moundville soils. The remaining 8 percent is the Yahara, Keowns, and other minor soils.

The Granby soils are coarse textured and poorly drained. They are underlain by moderately alkaline sand at a depth of more than 17 inches. Ground water is at or near the surface most of the time. Granby soils have loamy substratum phases in this association. The somewhat poorly drained Tedrow soils are similar to the Granby soils and also have loamy substratum phases, but ground water is slightly farther below the surface and is near the surface for shorter periods of time. The moderately well drained Moundville soils have a moderately coarse to coarse subsoil that is about 20 to 40 inches deep over acid sand. Ground water is more than 3 feet from the surface most of the time.

The native vegetation was mixed wetland hardwoods and wetland grasses. Much of this association is in woodland or permanent pasture. Some areas have been cleared and drained for cultivation. Because of the sandy surface layer of these soils, cleared and drained areas are subject to soil blowing.

6. *Houghton-Adrian association*

Deep, very poorly drained, moderately rapidly permeable soils that have an organic subsoil over organic material or sand

This association is distributed mostly in the southern and eastern parts of the county. The major soils are in broad, irregularly shaped areas that are lower than areas of surrounding soils (fig. 3).

This association makes up about 18 percent of the county. It consists of about 45 percent Houghton soils and 40 percent Adrian soils. The remaining 15 percent is the deep stratified variant of the Adrian series and the Palms and Rollins soils.

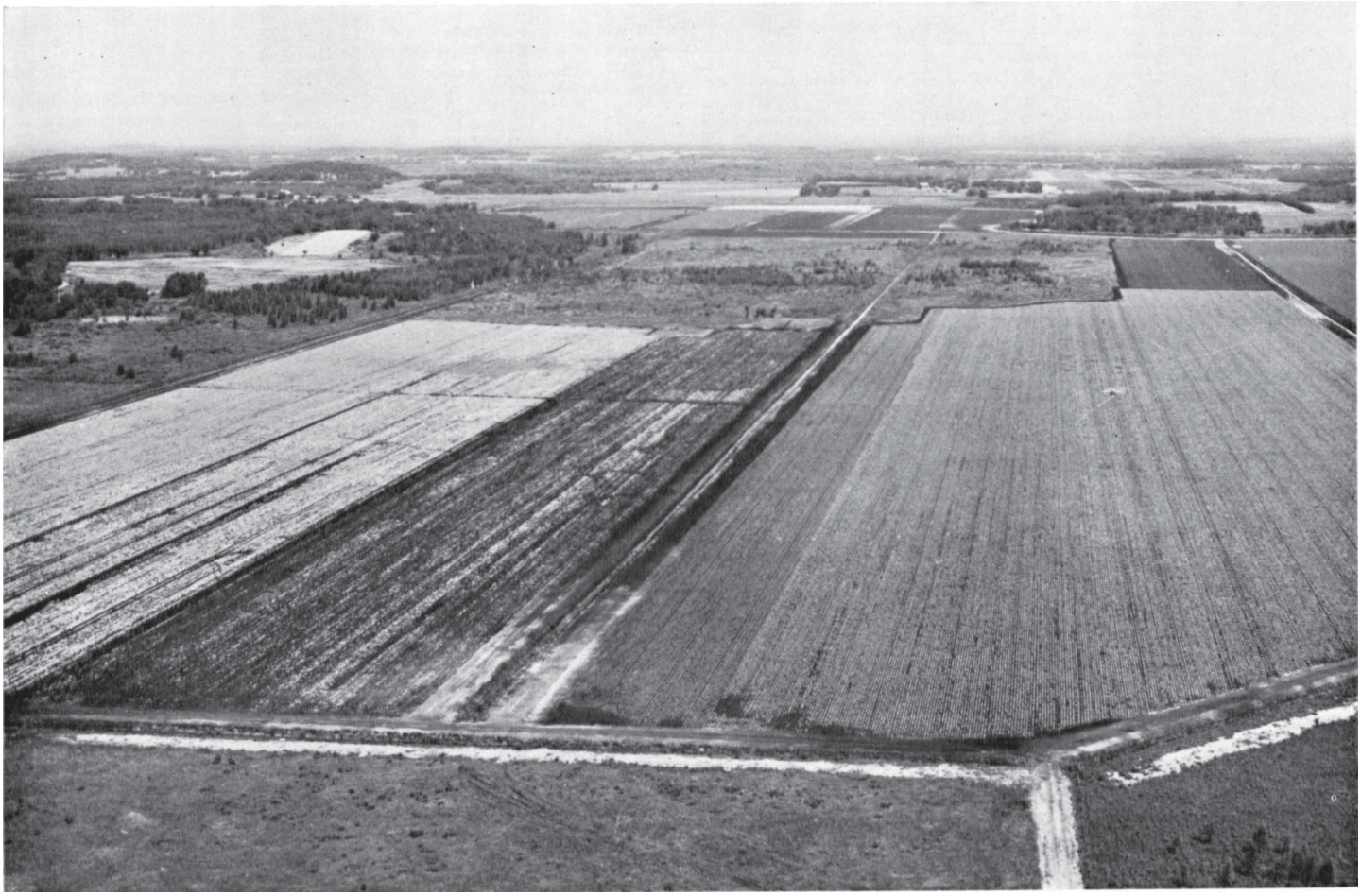

Figure 3.—**Landscape in the Houghton-Adrian association shows artificially drained soils used for truck crops.**

The Houghton soil is a deep mucky peat that extends to a depth of more than 48 inches. The Adrian soils have two depths; one soil has 30 to 48 inches of mucky peat over loam, fine sandy loam, and loamy fine sand, and the other has only 10 to 30 inches of mucky peat over sand.

The native vegetation was mainly sedges, grasses, and reeds that were encroached on in places by tamarack. In some areas the soils have been drained and cultivated. Drained areas are suited to cultivation where protected from subsidence and soil blowing. Some areas are in tamarack and other wetland trees or are idle. In cultivated areas, controlling the water table and planting shelterbelts help prevent loss of organic soil. These practices control soil blowing and prevent subsidence by oxidation.

7. *Oshtemo-Gotham association*

Deep, well-drained, moderately rapidly permeable and rapidly permeable soils that have a sandy loam and loamy fine sand subsoil over sandy outwash

This association is distributed mainly in the east-central and southeastern parts of the county. In most places the major soils are nearly level to sloping and are on outwash terraces.

This association makes up about 16 percent of the county. It consists of about 50 percent Oshtemo soils and 25 percent Gotham soils. The remaining 25 percent is Boyer, Casco, Lorenzo, Fox, and other soils.

Oshtemo soils have a moderately coarse subsoil that extends to a depth of about 45 inches and is over limy outwash sand and gravel. Gotham soils have a coarse to moderately coarse subsoil that is 20 to 40 inches thick and is over acid outwash sand.

In a few areas the soils are steeper than sloping and occur on eskers and kames and on the sides of steep pits. The Oshtemo soils commonly occur on the higher positions and are generally more sloping than the lower lying Gotham soils. The Gotham soils occur on the foot slopes and in draws more commonly than do the Oshtemo soils.

The native vegetation was mainly black oak that had some openings. Much of this association has been cleared, and these areas are suited to cultivation if they are protected against water erosion and soil blowing. The steeper soils are used mainly for pasture and as woodland. Controlling erosion is important, for moderate water erosion and soil blowing occur on much of the cleared acreage. Conserving water and organic matter is important because these soils have low available water capacity. Conservation practices, such as constructing diversion terraces, strip-

cropping, and planting shelterbelts, retard soil erosion and conserve water.

8. *Mecan-Metea association*

Deep, well-drained, moderately permeable and moderately rapidly permeable soils that have a sandy loam and sandy clay loam subsoil over loamy glacial till

This association is scattered in small areas throughout the county. It is made up mostly of the well-drained loamy fine sands and fine sandy loams.

This association consists of about 2 percent of the county. This association consists of about 40 percent Mecan soils, 45 percent Metea soils, and 15 percent Delton, Briggsville, and other minor soils.

The Mecan and Metea soils are both loamy fine sands and the fine sandy loams. The Mecan soils have a moderately coarse subsoil that extends to a depth of about 45 inches and are underlain by a moderately fine subsoil over sandy till. Metea fine sandy loam, sandy substratum, is underlain by sandy outwash. The Mecan and Metea soils both occupy ridges and hills in this association.

The native vegetation was mixed hardwoods, mainly oaks. Much of this association has been cleared and is suited to cultivation if carefully managed and protected against water erosion and soil blowing. Steeper areas are used mainly for pasture and as woodland. Erosion control is important. Much of the cleared acreage is moderately eroded. Conservation practices such as building diversion terraces and stripcropping help to control erosion and to conserve organic matter.

Descriptions of the Soils

This section describes the soil series and mapping units of Marquette County. The acreage and proportionate extent of each mapping unit are given in table 1.

The procedure is first to describe the soil series, and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. As mentioned in the section "How this Soil Survey was Made," not all mapping units are members of a soil series. Alluvial land and Marsh, for example, are miscellaneous land types that do not belong in a soil series. They are listed, nevertheless, in alphabetic order along with the soil series.

An important part of the description of each soil series is the soil profile; that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for moist soil unless otherwise stated.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit, woodland suitability group, recreation suitability group, and wildlife suitability group in which the mapping unit has been placed. The pages on which each of these units and groups are described can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

Adrian Series

The Adrian series consists of deep, very poorly drained, organic soils that are underlain by sand. Ground water is at or near the surface throughout the year. These soils formed in sedges and marsh grasses that are encroached on in places by tamarack and shrubs.

In a representative profile the surface layer is black mucky peat 12 inches thick. Very dark brown and black muck is between depths of 12 and 36 inches. The substratum is olive-gray sand.

Adrian soils are moderately rapidly permeable. They have high available water capacity and low natural fertility.

Representative profile of Adrian mucky peat, deep, in a cultivated field, NW¼SE¼ sec. 26, T. 14 N., R. 8 E. (The first 12 inches have been disturbed by plowing.)

Oa1—0 to 12 inches, black (5YR 2/1) sapric material; few, fine, hairlike, yellowish-brown (10YR 5/4) fibers; weak, fine, granular structure; very friable; medium acid; clear, smooth boundary.

Oa2—12 to 24 inches, very dark brown (10YR 2/2) sapric material; weak, granular structure; common, fine, distinct, yellowish-brown (10YR 5/4) sedge fibers; very friable; medium acid; clear, abrupt boundary.

Oa3—24 to 36 inches, black (10YR 2/1) sapric material; weak, fine, granular structure; friable; medium acid; gradual, smooth boundary.

IIC—36 to 60 inches, olive-gray (5Y 4/2) sand; single grained; loose; medium acid.

The surface layer is generally mucky peat. Depth to the underlying sand ranges from 16 to 48 inches.

Adrian soils have a sandy substratum, whereas the associated Palms soils have a loamy substratum. Adrian soils are underlain by mineral soil at a depth of 16 to 48 inches, which is shallower than the mineral soil underlying the associated Houghton soils.

Adrian mucky peat, deep (0 to 2 percent slopes) (Ac).—This soil is on broad to long and narrow or irregularly shaped areas in the lowlands. It has the profile representative for the series.

Where drainage is practical and feasible, this soil is used for corn and specialty truck crops. Controlling the water table helps reduce oxidation and subsidence. (Capability unit IVw–7; woodland group 10; recreation group 1; wildlife group 6)

Adrian mucky peat, shallow (0 to 2 percent slopes) (Ad).—This soil is on broad to long and narrow or irregularly shaped areas in the lowlands. The profile of this soil is 16 to 30 inches to underlying sand, but the underlying sand in the representative profile is at a greater depth.

Included with this soil in mapping are a few areas of Houghton soils. Also included are sandy soils that have an organic surface layer as much as 16 inches thick. Other inclusions are small areas that have slopes of 5 percent.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent of county
Adrian mucky peat, deep	7,800	2.7
Adrian mucky peat, shallow	14,840	5.1
Adrian mucky peat, deep, stratified subsoil variant	3,650	1.3
Adrian mucky peat, shallow, stratified subsoil variant	3,050	1.1
Alluvial land	200	.1
Alluvial land, wet	4,450	1.5
Ankeny fine sandy loam	235	.1
Boyer loamy fine sand, 2 to 6 percent slopes	1,500	.4
Boyer loamy fine sand, 6 to 12 percent slopes, eroded	1,800	.6
Boyer loamy fine sand, 12 to 20 percent slopes, eroded	770	.2
Boyer loamy fine sand, 20 to 30 percent slopes, eroded	840	.3
Boyer fine sandy loam, 2 to 6 percent slopes	410	.1
Boyer fine sandy loam, 6 to 12 percent slopes, eroded	860	.3
Boyer fine sandy loam, 12 to 20 percent slopes, eroded	315	.1
Boyer-Oshtemo loamy sands, 2 to 6 percent slopes	400	.1
Boyer-Oshtemo loamy sands, 6 to 12 percent slopes, eroded	300	.1
Boyer fine sandy loam, dark surface variant, 0 to 2 percent slopes	540	.2
Boyer fine sandy loam, dark surface variant, 2 to 6 percent slopes	910	.3
Boyer fine sandy loam, dark surface variant, 6 to 12 percent slopes, eroded	245	.1
Briggsville loam, 0 to 2 percent slopes	290	.1
Briggsville loam, 2 to 6 percent slopes	3,790	1.3
Briggsville loam, 6 to 12 percent slopes, eroded	480	.2
Briggsville loam, 12 to 20 percent slopes, eroded	170	.1
Briggsville silt loam, 0 to 2 percent slopes	620	.2
Briggsville silt loam, 2 to 6 percent slopes	1,260	.4
Casco fine sandy loam, 2 to 6 percent slopes	810	.3
Casco fine sandy loam, 6 to 12 percent slopes, eroded	500	.2
Casco fine sandy loam, 12 to 20 percent slopes, eroded	270	.1
Casco fine sandy loam, 20 to 30 percent slopes, eroded	560	.2
Colwood fine sandy loam	2,000	.7
Delton loamy fine sand, 1 to 6 percent slopes	970	.3
Delton loamy fine sand, 6 to 12 percent slopes, eroded	340	.1
Delton fine sandy loam, 0 to 2 percent slopes	840	.3
Delton fine sandy loam, 2 to 6 percent slopes	3,700	1.3
Delton fine sandy loam, 6 to 12 percent slopes, eroded	710	.2
Fox sandy loam, 2 to 6 percent slopes	300	.1
Fox sandy loam, 6 to 12 percent slopes, eroded	540	.2
Fox loam, 2 to 6 percent slopes	450	.2
Fox loam, 6 to 12 percent slopes, eroded	385	.1
Gotham loamy fine sand, 0 to 2 percent slopes	8,400	2.9
Gotham loamy fine sand, 2 to 6 percent slopes	18,830	6.5
Gotham loamy fine sand, 6 to 12 percent slopes	3,950	1.4
Gotham loamy fine sand, 12 to 20 percent slopes	1,300	.4
Gotham loamy fine sand, loamy substratum, 0 to 2 percent slopes	1,100	.4
Gotham loamy fine sand, loamy substratum, 2 to 6 percent slopes	7,290	2.5
Gotham loamy fine sand, loamy substratum, 6 to 12 percent slopes, eroded	3,400	1.2
Gotham loamy fine sand, loamy substratum, 12 to 20 percent slopes, eroded	1,600	.6
Gotham fine sandy loam, 0 to 2 percent slopes	660	.2
Gotham fine sandy loam, 2 to 6 percent slopes	920	.4
Gotham fine sandy loam, loamy substratum, 1 to 3 percent slopes	860	0.3
Granby loamy fine sand	2,650	.9
Granby fine sandy loam	9,850	3.4
Granby fine sandy loam, loamy substratum	6,450	2.3
Houghton mucky peat	24,900	8.6
Houghton peat, acid variant	150	.1
Keowns fine sandy loam	660	.2
Lapeer-Pardeeville fine sandy loams, 2 to 6 percent slopes	2,910	1.0
Lapeer-Pardeeville fine sandy loams, 6 to 12 percent slopes, eroded	1,950	.7
Lapeer-Pardeeville fine sandy loams, 12 to 20 percent slopes, eroded	1,200	.4
Lapeer-Pardeeville fine sandy loams, 20 to 30 percent slopes, eroded	930	.4
Lorenzo loam, 0 to 2 percent slopes	150	.1
Lorenzo loam, 2 to 6 percent slopes	280	.1
Marsh	1,800	.6
Mecan loamy fine sand, 12 to 20 percent slopes, eroded	760	.2
Mecan loamy fine sand, 20 to 30 percent slopes, eroded	520	.2
Mecan fine sandy loam, 2 to 6 percent slopes	2,800	.9
Mecan fine sandy loam, 6 to 12 percent slopes, eroded	2,200	.7
Metea loamy fine sand, 2 to 6 percent slopes	445	.1
Metea loamy fine sand, 6 to 12 percent slopes, eroded	170	.1
Metea loamy fine sand, 12 to 20 percent slopes	170	.1
Metea loamy fine sand, sandy substratum, 2 to 6 percent slopes	1,010	.3
Metea loamy fine sand, sandy substratum, 6 to 12 percent slopes, eroded	240	.1
Metea fine sandy loam, 2 to 6 percent slopes	1,250	.4
Metea fine sandy loam, 6 to 12 percent slopes	1,250	.4
Metea fine sandy loam, 12 to 20 percent slopes, eroded	450	.1
Metea fine sandy loam, sandy substratum, 2 to 6 percent slopes	660	.2
Metea fine sandy loam, sandy substratum, 6 to 12 percent slopes, eroded	520	.2
Metea fine sandy loam, stratified substratum, 0 to 2 percent slopes	720	.2
Metea fine sandy loam, stratified substratum, 2 to 6 percent slopes	2,750	.9
Metea fine sandy loam, stratified substratum, 6 to 12 percent slopes	1,050	.4
Montello loam, 0 to 2 percent slopes	540	.2
Montello loam, 2 to 6 percent slopes	1,050	.4
Montello silt loam, 0 to 2 percent slopes	1,050	.4
Montello silt loam, 2 to 6 percent slopes	1,300	.4
Mosel fine sandy loam, 0 to 3 percent slopes	1,850	.6
Mosel loam, 0 to 3 percent slopes	840	.3
Moundville loamy fine sand, 0 to 3 percent slopes	6,600	2.3
Moundville fine sandy loam, 0 to 3 percent slopes	3,000	1.0
Mundelein loam, 0 to 3 percent slopes	1,500	.5
Mundelein silt loam, 0 to 3 percent slopes	2,700	.9
Oshtemo loamy fine sand, 0 to 2 percent slopes	1,260	.4
Oshtemo loamy fine sand, 2 to 6 percent slopes	11,600	4.0
Oshtemo loamy fine sand, 6 to 12 percent slopes, eroded	6,050	2.1
Oshtemo loamy fine sand, 12 to 20 percent slopes, eroded	3,150	1.1
Oshtemo fine sandy loam, 0 to 2 percent slopes	340	.1
Oshtemo fine sandy loam, 2 to 6 percent slopes	1,750	.5
Oshtemo fine sandy loam, 6 to 12 percent slopes, eroded	340	.1

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil	Acres	Percent of county	Soil	Acres	Percent of county
Palms mucky peat, deep	840	0. 3	Sisson loam, 0 to 2 percent slopes	180	0. 1
Palms mucky peat, shallow	1, 250	. 4	Sisson loam, 2 to 6 percent slopes	800	. 3
Plainfield sand, 0 to 12 percent slopes, eroded	1, 250	. 4	Steep sandy land	2, 900	1. 0
Plainfield sand, 12 to 20 percent slopes, eroded	460	. 1	Tedrow loamy fine sand, 0 to 3 percent slopes	4, 000	1. 4
Plainfield loamy fine sand, 0 to 2 percent slopes	3, 600	1. 2	Tedrow loamy fine sand, loamy substratum, 0 to 3 percent slopes	1, 600	. 5
Plainfield loamy fine sand, 2 to 6 percent slopes	16, 500	5. 7	Tedrow fine sandy loam, 0 to 3 percent slopes	3, 470	1. 2
Plainfield loamy fine sand, 6 to 12 percent slopes	7, 400	2. 6	Tedrow fine sandy loam, loamy substratum, 0 to 3 percent slopes	1, 650	. 6
Plainfield loamy fine sand, 12 to 20 percent slopes, eroded	5, 340	1. 8	Wyocena loamy fine sand, 2 to 6 percent slopes	1, 800	. 6
Plainfield-Wyocena complex, 2 to 6 percent slopes	235	. 1	Wyocena loamy fine sand, 6 to 12 percent slopes	1, 350	. 4
Plainfield-Wyocena complex, 6 to 12 percent slopes	300	. 1	Wyocena loamy fine sand, 12 to 20 percent slopes	1, 300	. 4
Plainfield-Wyocena complex, 12 to 30 percent slopes	520	. 3	Wyocena loamy fine sand, 20 to 30 percent slopes	580	. 2
Poygan fine sandy loam	680	. 2	Wyocena fine sandy loam, 2 to 6 percent slopes	375	. 1
Poygan silty clay loam	2, 800	1. 0	Wyocena fine sandy loam, 6 to 12 percent slopes, eroded	285	. 1
Rollin mucky peat	220	. 1	Yahara fine sandy loam, 0 to 3 percent slopes	1, 480	. 5
Seward fine sandy loam, 0 to 2 percent slopes	160	. 1			
Seward fine sandy loam, 2 to 6 percent slopes	720	. 2	Total	291, 200	100. 0
Sisson fine sandy loam, 0 to 2 percent slopes	520	. 2			
Sisson fine sandy loam, 2 to 6 percent slopes, eroded	460	. 1			

This soil is susceptible to soil blowing and subsidence where drained. Where drainage is practical, this soil is used for corn and specialty crops. Controlling the water table helps to control severe damage by soil blowing in drained and cultivated areas. (Capability unit IVw–7; woodland group 10; recreation group 1; wildlife group 6)

Adrian Series, Stratified Subsoil Variant

The stratified subsoil variant of the Adrian series consists of deep, moderately rapidly permeable soils underlain by a stratified loamy and sandy substratum. Ground water is at or near the surface throughout the year. These soils formed under sedges and marsh grasses that are encroached on in places by tamarack and shrubs. They formed in decaying fibrous plant residues that overlie stratified silt and fine sand.

In a representative profile the surface layer is black mucky peat 12 inches thick. Below this, to a depth of 36 inches, is black peaty muck and muck. The substratum is thinly layered black loam, very dark gray fine sandy loam, and grayish-brown loamy fine sand and fine sandy loam.

These soils have high available water capacity and are low in natural fertility.

Representative profile of Adrian mucky peat, deep, stratified subsoil variant, in an uncultivated area NW¼ SW¼ sec. 34, T. 14 N., R. 8 E.

Oa1—0 to 12 inches, black (N 2/0) sapric material; weak, medium, granular structure; very friable; mildly alkaline; gradual, smooth boundary.

Oa2—12 to 24 inches, black (N 2/0) sapric material; few, fine, distinct, light olive-brown (2.5Y 5/4) plant fibers; weak, medium, granular structure; very friable; mildly alkaline; gradual, smooth boundary.

Oa3—24 to 32 inches, black (5YR 2/1) sapric material; common, fine, prominent, yellowish-brown (10YR 5/4) plant fibers; weak, medium, granular structure; very friable; mildly alkaline; gradual, wavy boundary.

Oa4—32 to 36 inches, black (10YR 2/1) sapric material; few, fine, prominent, yellowish-brown (10YR 5/4) plant fibers; massive; friable; neutral; clear, smooth boundary.

IIC1—36 to 40 inches, black (10YR 2/1) loam; few intermingled fine, prominent, dark yellowish-brown (10YR 3/4) plant stems and fibers; massive; firm; mildly alkaline; clear, smooth boundary.

IIC2—40 to 44 inches, very dark gray (N 3/0) fine sandy loam; many, coarse, distinct, grayish-brown (2.5Y 5/2) streaks and mottles; massive; friable; neutral; clear, smooth boundary.

IIC3—44 to 60 inches, grayish-brown (2.5Y 5/2) loamy fine sand and fine sandy loam; stratified; massive; friable to firm; neutral to mildly alkaline.

Depth of organic soil over the underlying sand and silt ranges from 16 to 48 inches. The Oa1 horizon is mucky peat in most areas, but local areas of muck occur. The underlying mineral soil ranges from silt and fine sand to loam and layers of clay and silt. In most areas soils show evidence of stratified or alluvial deposits in the substratum.

The stratified subsoil variant of the Adrian soils is underlain by stratified silt and sand, but the associated Palms, Adrian, and Rollin soils are underlain by loam, sand, and marl, respectively.

Adrian mucky peat, deep, stratified subsoil variant (0 to 2 percent slopes) (Ae).—This soil is on broad to long and narrow or irregularly shaped areas in the lowlands. Its profile is representative of the series.

Where drainage is practical, this soil is used for corn and truck crops. Controlling the water table helps to reduce oxidation and subsidence. (Capability unit IVw–7; woodland group 10; recreation group 1; wildlife group 6)

Adrian mucky peat, shallow, stratified subsoil variant (0 to 2 percent slopes) (Ak).—This soil is in broad to long and narrow or irregularly shaped areas in the lowlands. Its profile is shallower over silt and fine sand (16 to 30 inches) than the representative profile.

Included with this soil in mapping are areas of a mineral soil that has an organic surface layer 16 inches thick.

This soil is susceptible to soil blowing and subsidence if it is drained. Where drainage is practical, this soil is used for corn and truck crops. Controlling the water table helps to reduce oxidation and subsidence. (Capability unit IVw–7; woodland group 10; recreation group 1; wildlife group 6)

Alluvial Land

Alluvial land is a miscellaneous land type that consists of unconsolidated alluvium or colluvium. Areas of deep, sandy and loamy alluvial soils are on the flood plains of streams or in very small depressional areas surrounded by uplands. Where it is adjacent to streams, Alluvial wetland is subject to frequent flooding.

Alluvial land (0 to 2 percent slopes) (Am).—This land type consists of deep, sandy and loamy alluvial and colluvial soils. The texture of the surface layer is variable, even within small areas. It ranges from loamy fine sand to loam.

Alluvial land is better suited to pasture, trees, or wildlife than to cultivation. (Capability unit IIIw–12; woodland group 9; recreation group 5; wildlife group 7)

Alluvial land, wet (0 to 2 percent slopes) (An).—This land type is similar to Alluvial land except that ground water is at or near the surface of the soil throughout the year.

Alluvial areas adjacent to streams are subject to frequent flooding. Colluvial depressions on uplands have a high ground-water table and frequently have water standing on the surface. Generally drainage is not feasible. Texture ranges from loamy fine sand to loam and is quite variable within small areas. Some areas have thin organic layers interlaid in the alluvial strata.

Alluvial land, wet, is seldom used for crops, because it has an unfavorable position on the landscape that causes wetness. Also, it has a very small acreage. It is better suited to pasture, trees, or wildlife than to cultivation. (Capability unit IVw–5; woodland group 9; recreation group 3; wildlife group 5b)

Ankeny Series

The Ankeny series consists of well-drained, nearly level, loamy soils. These soils formed in the alluvial or colluvial deposits.

In a representative profile the surface layer is about 30 inches of very dark grayish-brown and very dark gray fine sandy loam. The subsoil is dark yellowish-brown and yellowish-brown fine sandy loam and loam about 15 inches thick. The substratum is yellowish-brown loamy fine sand.

Ankeny soils have medium available water capacity and moderately rapid permeability. Natural fertility is low.

Representative profile of Ankemy fine sandy loam (0 to 2 percent slopes), in a cultivated field, NW¼SE¼ sec. 18, T. 15 N., R. 8 E.

A11—0 to 18 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; weak, medium, granular structure; very friable; medium acid; clear, smooth boundary.

A12—18 to 23 inches, very dark gray (10YR 3/1) fine sandy loam; weak, medium, granular structure; very friable; medium acid; clear, smooth boundary.

A13—23 to 30 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; weak, medium, granular structure; very friable; medium acid; gradual, smooth boundary.

B1—30 to 35 inches, dark yellowish-brown (10YR 3/4) fine sandy loam; weak, medium, granular structure; very friable; medium acid; gradual, smooth boundary.

B2—35 to 40 inches, dark yellowish-brown (10YR 4/4) loam; weak, medium, subangular blocky structure; friable; medium acid; gradual, smooth boundary.

B3—40 to 45 inches, yellowish-brown (10YR 5/6) fine sandy loam; weak, fine, subangular blocky structure; very friable; medium acid; gradual, smooth boundary.

C—45 to 60 inches, yellowish-brown (10YR 5/8) loamy fine sand; weak, fine, subangular blocky structure; very friable; medium acid.

The dark-colored A horizon ranges from 12 to 45 inches in thickness. The A11 horizon ranges from very dark grayish-brown (10YR 3/2) to very dark brown (10YR 2/2). The colluvial deposits range from fine sandy loam to loam.

The Ankeny soils in Marquette County have a slightly more acid solum than in the defined range for the series, but this does not alter their usefulness or behavior.

Ankeny soils are finer textured than the associated Gotham soils and dark colored to a greater depth.

Ankeny fine sandy loam (0 to 2 percent slopes) (Ao).—This soil occupies long narrow draws and small depressions in the uplands.

Included with this soil in mapping are small areas that have a loam surface layer. The texture of surface layer and subsoil in this mapping unit is fairly variable within mapped areas. Also included are some gently sloping soils.

Soil blowing and erosion are slight hazards where runoff is concentrated. These soils are subject to flooding by the runoff water from higher surrounding areas.

The soils are suited to all crops commonly grown in the county. (Capability unit IIIw–12; woodland group 1; recreation group 5; wildlife group 4)

Boyer Series

The Boyer series consists of well-drained sandy and loamy soils that are moderately deep over sand or sand and gravel. They are mostly in the central part of the county. Ground water is at a depth of more than 5 feet throughout the year. These soils formed under mixed hardwoods in calcareous sandy glacial outwash.

In a representative profile the surface layer is dark grayish-brown loamy fine sand 8 inches thick. The subsoil is 20 inches of yellowish-red and dark yellowish-brown sandy loam. The substratum is pale-yellow sand and gravel.

Boyer soils have a low available water capacity. Permeability is moderately rapid, and natural fertility is low.

Representative profile of Boyer loamy fine sand, 6 to 12 percent slopes, eroded, in a cultivated field, SW¼ NW¼ sec. 14, T. 16 N., R. 10 E.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loamy fine sand; weak, medium, subangular blocky structure; friable; moderately alkaline; abrupt, smooth boundary.

B21t—8 to 26 inches, yellowish-red (5YR 4/6) heavy sandy loam; moderate, medium, blocky structure; clay films on horizontal and vertical ped faces; friable; slightly acid; gradual, wavy boundary.

B3—26 to 28 inches, dark yellowish-brown (10YR 3/4) sandy loam; moderate, medium, subangular blocky structure; clay bridging; slightly acid; clear, wavy boundary.

C—28 to 60 inches, pale-yellow (2.5YR 8/4) sand and gravel; single grained; loose; moderately alkaline; gravel not very abundant.

The solum ranges from 24 to 36 inches in thickness and from slightly acid to neutral. The Ap horizon is loamy fine sand or fine sandy loam. In some undisturbed areas the A1 horizon is thin (less than 4 inches thick) and black or very dark grayish-brown (10YR 2/1-10YR 2/2). The B horizon ranges from sandy loam to sandy clay loam. The sandy clay loam is generally less than 10 inches thick. The gravel content of the C horizon ranges from none to very gravelly.

Boyer soils are shallower to the calcareous substratum than are the Oshtemo soils, because Boyer soils have a thinner loamy sand horizon above the B2 horizon. Boyer soils are coarser textured in the B horizon than are the Fox soils, and the dolomitic gravel content of the C horizon is lower. All of these soils are underlain by sand or sand and gravel outwash.

Boyer loamy fine sand, 2 to 6 percent slopes (BmB).—This soil has slopes that are less than 300 feet long in most places and are irregular in shape. The profile of this soil has a thicker subsoil in most areas than the profile described as representative for the series.

Included with this soil in mapping are some moderately eroded areas. Also included are small areas that are nearly level.

This soil is too sandy for intensive cultivation. It is moderately susceptible to soil blowing and slightly susceptible to water erosion. This soil is suited to all crops commonly grown in the county. (Capability unit IIIs–4; woodland group 4; recreation group 5; wildlife group 3)

Boyer loamy fine sand, 6 to 12 percent slopes, eroded (BmC2).—This soil has slopes that are less than 300 feet long in most places. Soil areas are elongated to irregular in shape. The surface layer is about 7 inches thick. The profile of this soil has a thinner and lighter colored surface layer than the profile described as representative for the series.

Included with this soil in mapping are some areas of soils that have complex rolling slopes. Also included are areas where erosion is slight, especially where the soil is in permanent pasture and trees. In other small included areas erosion is severe.

This soil is too strongly sloping for intensive cultivation. It is susceptible to soil blowing and water erosion. Some unprotected areas are damaged by erosion. This soil is suited to all the crops commonly grown in the county. (Capability unit IIIe–7; woodland group 4; recreation group 5; wildlife group 3)

Boyer loamy fine sand, 12 to 20 percent slopes, eroded (BmD2).—The slopes of this soil are less than 200 feet long in most places. Soil areas are elongated to irregular in shape. The profile of this soil has a thinner and lighter colored surface layer and a thinner subsoil than the profile described as representative for the series. The surface layer is about 6 inches thick, and the subsoil is about 15 inches thick. The organic-matter content, level of fertility, and available water capacity are lower than in the uneroded soil.

Included with this soil in mapping are small areas of Oshtemo soils and areas of a soil that has complex slopes. Also included are some areas of soils that are only slightly eroded and are used as woodland and for permanent pasture. In some areas of Springfield Township the soil has a surface layer of coarser loamy sand.

This soil is too steep for safe cultivation, and it is susceptible to soil blowing and erosion. Although most crops commonly grown in the county can be grown on this soil, it is better suited to hay or pasture. Woodland and wildlife habitat also are suitable uses. (Capability unit IVe–7; woodland group 4; recreation group 5; wildlife group 3)

Boyer loamy fine sand, 20 to 30 percent slopes, eroded (BmE2).—This soil has slopes that are less than 200 feet long in most places. Soil areas are elongated to irregular in shape. The surface layer is thinner and lighter colored than the one described as representative for the series, and the subsoil is thinner.

Included with this soil in mapping are some areas of a soil that has complex slopes. Also included are some areas of Oshtemo soils. Other inclusions are areas of permanent pasture and woodland that are only slightly eroded and small areas that are severely eroded.

This soil is too steep for safe cultivation. It is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower. This soil is suitable as woodland and for wildlife habitat. (Capability unit VIIe–4; woodland group 4; recreation group 5; wildlife group 3)

Boyer fine sandy loam, 2 to 6 percent slopes (BnB).—This soil has slopes that are less than 300 feet long in most places. Soil areas are irregular in shape. The surface layer is finer textured than in the profile described as the representative for the series, and the subsoil is slightly thicker.

Included with this soil in mapping are some areas of undulating soils. Also included are some small areas of moderately eroded soils.

This soil is suited to all crops commonly grown in the county. Erosion is a moderate hazard. (Capability unit IIIs–4; woodland group 3; recreation group 5; wildlife group 1)

Boyer fine sandy loam, 6 to 12 percent slopes, eroded (BnC2).—This soil has slopes that are less than 200 feet long in most places. Soil areas are elongated to irregular in shape (fig. 4). The surface layer is about 6 inches thick. It is thinner, finer textured, and lighter colored than the surface layer in the profile described as representative for the series.

Included with this soil in mapping are some areas of soils that have complex rolling slopes. Also included are small areas of the Oshtemo soils. Other inclusions are areas of woodland and permanent pasture that are only slightly eroded.

This soil is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIe–7; woodland group 3; recreation group 5; wildlife group 1)

Boyer fine sandy loam, 12 to 20 percent slopes, eroded (BnD2).—This soil has slopes that are less than 200

Figure 4.—**Typical landscape of Boyer soils under cultivation.**

feet long in most places. Soil areas are elongated to irregular in shape. The surface layer is 5 inches thick. It is thinner, lighter colored, and finer textured than the surface layer in the profile described as representative for the series.

Included with this soil in mapping are some areas of soils that have complex slopes. Also included are areas in woodland and permanent pasture that are slightly eroded. Other inclusions are small areas where the surface layer is darker and some areas of Oshtemo soils. Small areas are severely eroded.

This soil is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to most crops commonly grown in the county but it is better suited to hay or pasture. Also, it is suitable as woodland and for wildlife habitat. (Capability unit IVe–7; woodland group 3; recreation group 5; wildlife group 1)

Boyer-Oshtemo loamy sands, 2 to 6 percent slopes (BrB).—This complex consists of about 55 percent Boyer soils and 45 percent Oshtemo soils. It has slopes that are less than 300 feet long in most places. Soil areas are irregular in shape.

The profiles of the soils in this complex have coarser sand in the surface layer and are more acid than the profiles representative for Boyer and Oshtemo soils.

Included with this complex in mapping are some areas of moderately eroded soils and some soils that have complex slopes.

These soils are susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface layer is thinner and the organic-matter content, fertility, and available water capacity are lower than in uneroded soils. (Capability unit IIIs–4; woodland group 4; recreation group 5; wildlife group 3)

Boyer-Oshtemo loamy sands, 6 to 12 percent slopes, eroded (BrC2).—This complex consists of about 60 percent Boyer soils and 40 percent Oshtemo soils. It has slopes that are less than 200 feet long in most places. Soil areas are irregular in shape.

The profiles of the soils in this complex have a thinner, coarser, and lighter colored surface layer and a somewhat thinner subsoil than profiles representative for Boyer and Oshtemo soils. They are also more acid.

Included with these soils in mapping are wooded areas and areas in permanent pasture that are only slightly eroded.

This complex is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

These soils are suited to all the crops commonly grown in the county. (Capability unit IIIe–7; woodland group 4; recreation group 5; wildlife group 3)

Boyer Series, Dark Surface Variant

Boyer, dark surface variant soils are well-drained loamy soils that are moderately deep over sand or sand and gravel. They are mostly in the east-central part of the county. Ground water is at a depth of more than 5 feet throughout the year. These soils formed under native grasses and oak openings. They formed in calcareous sandy glacial outwash.

In a representative profile the surface layer is very dark brown fine sandy loam 6 inches thick. The subsurface soil is brown sandy loam 1 inch thick. The subsoil is about 26 inches thick. The upper 5 inches is dark reddish-brown sandy loam. The next 8 inches is strong-brown loamy sand, and the lower 3 inches is reddish-brown loamy sand. The substratum is brownish-yellow sand and gravel.

Boyer, dark surface variant soils have a low available water capacity, moderately rapid permeability, and medium natural fertility.

Representative profile of Boyer fine sandy loam, dark surface variant, 2 to 6 percent slopes, in an uncultivated area, SW¼NE¼ sec. 9, T. 17 N., R. 9 E.

A1—0 to 6 inches, very dark brown (10YR 2/2) fine sandy loam; weak, medium, blocky structure; friable; medium acid; abrupt, smooth boundary.

A2—6 to 7 inches, brown (7.5YR 5/4) sandy loam; weak, fine, subangular blocky structure; friable; medium acid; abrupt, smooth boundary.

B2t—7 to 12 inches, dark reddish-brown (5YR 3/4) sandy loam; moderate, medium subangular blocky structure; thin, patchy clay films on all ped faces; firm; medium acid; clear, smooth boundary.

B31—12 to 30 inches, strong-brown (7.5YR 5/6) loamy sand; moderate, medium, subangular blocky structure; friable; medium acid; clear, smooth boundary.

B32—30 to 33 inches, reddish-brown (5YR 4/4) loamy sand; moderate, medium, subangular blocky structure; friable; medium acid; clear, smooth boundary.

C—33 to 60 inches, brownish-yellow (10YR 6/6) sand and gravel; single grained; loose; some cobblestones and pebbles; moderately alkaline.

The A1 horizon of Boyer, dark surface variant soils is loamy fine sand or fine sandy loam. Local areas of sandy loam occur. The surface layer is very dark brown (10YR 2/2) or black (10YR 2/1). The solum ranges from 24 to 36 inches in thickness. The B2 horizon ranges from sandy loam to loam. The B3 horizon is loamy sand. The gravel content of the substratum ranges from none to very gravelly.

The Boyer, dark surface variant soils have a darker colored surface layer than the associated Boyer soils and an A2 horizon, which the associated Boyer soils lack.

Boyer fine sandy loam, dark surface variant, 0 to 2 percent slopes (BoA).—This soil occupies terraces on uplands. Soil areas are generally irregular in shape. The subsoil is about 35 inches thick.

Included with this soil in mapping are small areas of Lorenzo soils and of a soil that has a loam surface layer. Also included are small areas of a soil that has a lighter colored surface layer than this dark surface variant.

This soil is too droughty for intensive cultivation. It is susceptible to soil blowing. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all crops commonly grown in the county. Maintaining favorable organic-matter content and fertility helps to control erosion and to prevent soil deterioration. (Capability unit IIIs–4; woodland group 12; recreation group 5; wildlife group 4)

Boyer fine sandy loam, dark surface variant, 2 to 6 percent slopes (BoB).—This soil is in areas that are generally irregular in shape. Slopes are less than 300 feet long in most places. The profile of this soil is representative of the series.

Included with this soil in mapping are small areas of Lorenzo soils and areas that have a loam surface layer. Also included are small moderately eroded areas.

This soil is suited to all crops commonly grown in the county. Erosion is a moderate hazard to cultivation. Maintaining favorable organic-matter content and fertility helps to control erosion and to prevent soil deterioration. (Capability unit IIIs–4; woodland group 12; recreation group 5; wildlife group 4)

Boyer fine sandy loam, dark surface variant, 6 to 12 percent slopes, eroded (BoC2).—This soil has slopes that are less than 200 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a thinner, somewhat lighter colored surface layer than the profile described as representative of dark subsoil variants.

Included with this soil in mapping are small areas of Lorenzo soils and of soils that have a loam surface layer. Also included are areas of woods and permanent pasture that are only slightly eroded. In local areas complex rolling slopes occur.

This soil is too steep for intensive cultivation. It is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in the uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all crops commonly grown in the county. Maintaining favorable organic-matter content and fertility helps to control erosion and to prevent soil deterioration. (Capability unit IIIe–7; woodland group 12; recreation group 5; wildlife group 4)

Briggsville Series

The Briggsville series consists of deep, well-drained, silty soils that are underlain by lacustrine silt and clay. Ground water is at a depth of more than 5 feet throughout the year. These soils formed under mixed hardwoods.

In a representative profile the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is about 8 inches of light brownish-gray silt loam. The subsoil is about 27 inches thick. It is brown and reddish-brown silty clay loam in the upper 14 inches, and reddish-brown silty clay and silty clay loam in the lower 13 inches. The substratum is brown, calcareous heavy silty clay loam.

Briggsville soils have high available water capacity, moderately slow permeability, and high natural fertility.

Representative profile of Briggsville silt loam, 0 to 2 percent slopes, in a woodlot SE¼NW¼ sec. 22, T. 15 N., R. 8 E.

O1—1 inch to 0, dark-brown (10YR 4/3) mat of hardwood leaves containing some litter from grass and forbs.

A1—0 to 3 inches, very dark gray (10YR 3/1) silt loam that has moderate, fine, granular structure; friable; fine plant roots abundant; medium acid; clear, smooth boundary.

A2—3 to 11 inches, light brownish-gray (10YR 6/2) silt loam that has a high sand content; moderate, thin, platy structure; friable; plant roots are plentiful; medium acid; gradual, wavy boundary.

B1—11 to 17 inches, brown (7.5YR 5/4) silty clay loam that has moderate, medium, subangular blocky structure; friable; roots plentiful; light brownish-gray (10YR 6/2) bleached silt coatings on vertical faces of peds; strongly acid; gradual, wavy boundary.

B21t—17 to 25 inches, reddish-brown (5YR 4/4) heavy silty clay loam that has moderate to strong, medium, angular and subangular blocky structure; slightly hard when dry, slightly plastic when wet; thin, patchy clay films on all ped faces; roots plentiful; strongly acid; clear, wavy boundary.

B22t—25 to 32 inches, reddish-brown (5YR 4/3) silty clay that has weak, medium, prismatic structure that breaks to moderate to strong, medium, angular blocky structure; very firm; thin, patchy clay films on ped faces and black (5YR 2/1) spots of manganese or organic material; roots plentiful; medium acid; gradual, irregular boundary.

B3t—32 to 38 inches, reddish-brown (5YR 4/4) heavy silty clay loam that has moderate, medium, prismatic structure breaking to moderate, medium, angular blocky; very firm; few, thin, patchy clay flows and spots of manganese and organic matter; roots plentiful; slightly acid; clear, wavy boundary.

C—38 to 60 inches, brown (7.5YR 5/4) heavy silty clay loam that has weak, thick, platy structure; stratified; firm; moderately alkaline.

Depth to free carbonates ranges from 24 to more than 50 inches. Where free carbonates occur below a depth of 40 inches, the lower part of the solum is neutral to alkaline. The B2 horizon ranges from heavy silty clay loam to silty clay. Hue in the B and C horizons ranges from 7.5YR to 2.5YR. In some areas the C horizon is fine sandy loam or loam.

Briggsville soils are less friable throughout the profile than Sisson soils, which, unlike Briggsville soils, have developed in fine sand and coarse silt and have less than 35 percent clay in the B horizon. Briggsville soils have a lighter colored surface layer than Montello soils. All of these soils formed in lacustrine deposits.

Briggsville loam, 0 to 2 percent slopes (BsA).—This soil is in fairly large, broad areas and in areas that are small and irregular in shape. It has a coarser textured loam surface layer than that in the profile described as representative for the series.

Included with this soil in mapping are areas that have a sandy loam surface layer and local areas of a soil that has a darker surface layer than this Briggsville soil.

This soil is suited to all crops commonly grown in the county. It is slow to dry out in spring and after rains. Systems that remove surface water are beneficial in speeding drainage. With careful management continuous row crops can be grown safely. (Capability unit IIs–7; woodland group 1; recreation group 6; wildlife group 2)

Briggsville loam, 2 to 6 percent slopes (BsB).—This soil has slopes that are less than 300 feet long in most places. Soil areas are normally irregular in shape. The profile of this soil has a lighter colored and coarser textured surface layer than that in the profile described as representative for the series.

Included with this soil in mapping are areas of a soil that has a fine sandy loam surface layer. Also included are areas where the soil is underlain by loam to sandy loam till at a depth of more than 48 inches.

This soil is susceptible to water erosion. Because permeability is slow, runoff is rapid after heavy rains. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all crops commonly grown in the county. Maintaining favorable organic-matter content and fertility helps to control erosion and to prevent soil deterioration. (Capability unit IIe–6; woodland group 1; recreation group 6; wildlife group 2)

Briggsville loam, 6 to 12 percent slopes, eroded (BsC2).—This soil has slopes that are less than 200 feet long in most places. Soil areas are normally irregular in shape. The profile of this soil has a lighter colored and coarser textured surface layer than the profile described as representative for the series, and a thinner combined surface layer and subsoil (about 30 inches thick).

Included with this soil in mapping are areas of soil that has a silt loam or a sandy loam surface layer. Also included are areas of permanent pasture that are slightly eroded.

This soil is susceptible to erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than it is in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all crops commonly grown in the county. Maintaining favorable organic-matter content and fertility helps to control erosion and to prevent soil deterioration. (Capability unit IIIe–2; woodland group 1; recreation group 6; wildlife group 2)

Briggsville loam, 12 to 20 percent slopes, eroded (BsD2).—This soil has slopes that are less than 200 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a thinner, lighter colored surface layer than the profile described as representative for the series.

Included with this soil in mapping just north of Oxford are soils that have loam to fine sandy loam till in the substratum at a depth of more than 40 inches. Also included are small steep areas and areas of woods and permanent pasture that are slightly eroded.

This soil is susceptible to severe water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil can be used for most crops commonly grown in the county, but it is better suited to pasture or hay crops than to cultivated crops. Maintaining favorable organic-matter content and fertility helps to control erosion and to prevent soil deterioration. (Capability unit IIIe–2; woodland group 1; recreation group 6; wildlife group 2)

Briggsville silt loam, 0 to 2 percent slopes (BvA).—This soil is in areas that are fairly large and in areas that are small and irregular in shape. Its profile is representative of the series.

This soil is suited to all the crops commonly grown in the county. It is slow to dry out in the spring and after rains, and systems that remove surface water and speed up drainage are beneficial. Under a high level of man-

agement, row crops can be safely grown continuously. (Capability unit IIs–7; woodland group 1; recreation group 6; wildlife group 2)

Briggsville silt loam, 2 to 6 percent slopes (BvB).—This soil has slopes that are less than 300 feet long in most places. Soil areas are normally irregular in shape. The combined surface layer and subsoil of this soil are slightly thinner (about 34 inches thick) than in the profile described as representative of the series and the surface layer is somewhat lighter colored.

This soil is susceptible to water erosion. Because permeability is slow, runoff is rapid after heavy rains. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in the uneroded soil, and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all crops commonly grown in the county. Maintaining favorable organic-matter content and fertility helps to control erosion and to prevent soil deterioration. (Capability unit IIe–6; woodland group 1; recreation group 6; wildlife group 2)

Casco Series

The Casco series consists of well-drained, loamy soils that are shallow over sand or sand and gravel. Ground water is at a depth of more than 5 feet throughout the year. These soils formed under mixed hardwoods dominated by black oak in calcareous glacial outwash sand and gravel.

In a representative profile the surface layer is dark grayish-brown fine sandy loam 7 inches thick. The subsoil is brown sandy clay loam in the upper 7 inches and clay loam in the lower 5 inches. The substratum is yellowish-brown calcareous sand and gravel.

Casco soils have low available water capacity and moderate permeability. Natural fertility is medium. The substratum is rapidly permeable.

Representative profile of Casco fine sandy loam, 2 to 6 percent slopes, in a cultivated field, NW¼SE¼ sec. 26, T. 14 N., R. 10 E.

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) fine sandy loam; moderate, medium, granular structure; friable; medium acid; abrupt, smooth boundary.

B21t—7 to 14 inches, brown (7.5YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; firm; medium acid; clear, wavy boundary.

B22t—14 to 19 inches, brown (7.5YR 4/4) light clay loam; moderate, coarse and medium, subangular blocky structure; patchy dark-brown (7.5YR 3/2) coatings on peds; firm; few pebbles; medium acid; clear, wavy boundary.

C1—19 to 22 inches, yellowish-brown (10YR 5/4) gravelly sand, single grained; loose; moderately alkaline; partly weathered sandstone and limestone gravel.

C2—22 to 60 inches, yellowish-brown (10YR 5/4) sand and gravel; stratified; loose; moderately alkaline.

The solum ranges from 10 to 20 inches in thickness and is medium acid. The Ap horizon is generally fine sandy loam. In some undisturbed areas the A1 horizon is thin (less than 4 inches thick) and very dark grayish brown or very dark brown. The B22t horizon ranges from sandy clay loam to clay loam. The C horizon ranges from slightly gravelly to very gravelly.

Casco soils are shallower (10 to 20 inches) to calcareous outwash than the Fox and Boyer soils and have a thinner solum. Casco soils are finer textured in the B horizon than are Boyer and Oshtemo soils and the dolomitic gravel content of the C horizon is higher. All of these soils are underlain by sand or sand gravel outwash.

Casco fine sandy loam, 2 to 6 percent slopes (CaB).—This soil is in irregularly shaped areas, and slopes are generally less than 300 feet long. It has the profile representative for the Casco series.

Included with this soil in mapping are some areas of soils in Buffalo Township that have a somewhat darker surface layer. Also included are small areas of soils that have a moderately eroded loam surface layer, and areas of soils that are gently undulating. Other included areas are nearly level.

This soil is suited to all crops commonly grown in the county. Erosion is a moderate hazard. Maintaining fertility and organic-matter content helps to control erosion and to prevent soil deterioration. (Capability unit IIIe–4; woodland group 5; recreation group 5; wildlife group 3)

Casco fine sandy loam, 6 to 12 percent slopes, eroded (CaC2).—Most areas of this soil are elongated to irregular in shape, and slopes are generally less than 300 feet long. The profile of this soil has a thinner, lighter colored surface layer and a thinner solum (about 17 inches thick) than that representative of the series. The organic-matter content, fertility, and available water capacity are lower than in uneroded Casco soils.

Included with this soil in mapping are small areas of soils that have a loam surface layer. Also included are small areas of very shallow gravelly soils, and areas of soils that have complex slopes.

This soil is susceptible to soil blowing and erosion. It is suited to most crops grown in the county but is better suited to hay and pasture than to cultivated crops. Maintaining fertility level and organic-matter content helps to control erosion and to prevent soil deterioration. (Capability unit IVe–4; woodland group 5; recreation group 5; wildlife group 3)

Casco fine sandy loam, 12 to 20 percent slopes, eroded (CaD2).—This soil is in irregularly shaped areas, and slopes are generally less than 200 feet long (fig. 5). The profile of this soil has a thinner solum (about 16 inches thick) than that representative of the series and a thinner lighter colored surface layer. The organic-matter content, fertility, and available water capacity are lower than in the uneroded Casco soil.

Included with this soil in mapping are areas of the very shallow gravelly soils.

This soil is too strongly sloping for cultivation. It is susceptible to soil blowing and erosion. This soil is suited to pasture that has limited grazing and to woodland and wildlife habitat. The use of complete fertilizers helps to maintain these soils. (Capability unit VIe–4; woodland group 5; recreation group 5; wildlife group 3)

Casco fine sandy loam, 20 to 30 percent slopes, eroded (CaE2).—Most areas of this soil are generally elongated to irregular in shape, and slopes are generally less than 200 feet long.

The profile of this soil has a thinner combined surface layer and subsoil (about 14 inches thick) and a thinner, lighter colored surface layer than the representative profile. The organic-matter content, fertility, and available

Figure 5.—**Landscape of Casco fine sandy loam, 12 to 20 percent slopes, eroded.**

water capacity are lower than in the uneroded Casco soil.

Included with this soil in mapping are areas of soils that have a darker colored surface layer. Some areas where slopes are convex have inclusions of very shallow gravelly soils. Also included are areas that have complex slopes.

This soil is too strongly sloping for cultivation. It is susceptible to severe erosion. This soil is suited to pasture that has controlled grazing and to woodland and wildlife habitat. The use of complete fertilizers helps to maintain these soils. (Capability unit VIIe–4; woodland group 5; recreation group 5; wildlife group 3)

Colwood Series

The Colwood series consists of deep, poorly drained, nearly level, loamy soils in lowland drainageways and old lake basins. Ground water is at or near the surface throughout the year. These soils formed under sedges, grasses, and lowland hardwoods in lake-laid, stratified silt and fine sand.

In a representative profile the mineral surface layer is very dark brown fine sandy loam and loam about 8 inches thick. It is under about 4 inches of black muck. The subsoil is 4 inches of mottled, very dark brown clay loam in the upper part, 12 inches of dark-gray silty clay loam in the middle, and 8 inches of dark-gray loamy fine sand in the lower part. The substratum is yellowish-brown very fine sandy loam to loamy very fine sand.

Colwood soils have high available water capacity, moderate permeability, and medium natural fertility.

Representative profile of Colwood fine sandy loam in a wooded area, SE¼SE¼ sec. 30, T. 14 N., R. 9 E.

O—4 inches to 0, black (5YR 2/1) muck; weak, fine, granular structure; very friable; medium acid; clear, smooth boundary.

A1—0 to 3 inches, very dark brown (10YR 2/2) fine sandy loam; weak, fine, granular structure; very friable; slightly acid; clear, smooth boundary.

A3—3 to 8 inches, very dark brown (10YR 2/2) loam; weak, fine, granular to fine subangular blocky structure; friable; slightly acid; gradual, wavy boundary.

B21—8 to 12 inches, very dark brown (10YR 2/2) clay loam; common to many, prominent, yellowish-red (5YR 4/6) mottles; massive; firm; slightly acid; gradual, wavy boundary.

B22g—12 to 24 inches, dark-gray (10YR 4/1) silty clay loam; common, medium, prominent, yellowish-red (5YR 4/6) mottles; weak, coarse, subangular blocky structure to massive; firm; slightly acid; gradual, wavy boundary.

IIB3g—24 to 32 inches, dark-gray (10YR 4/1) loamy fine sand; single grained; weak, subangular blocky structure; slightly acid; wavy boundary.
IIC1—32 to 35 inches, yellowish-brown (10YR 5/6) very fine sandy loam; massive; firm; mildly alkaline; gradual, wavy boundary.
IIC2—35 to 60 inches, yellowish-brown (10YR 5/4) loamy very fine sand; common, distinct, strong-brown (7.5YR 5/6) mottles; single grained; loose; neutral to mildly alkaline.

The A1 horizon of Colwood soils ranges from fine sandy loam to silt loam. In some undisturbed areas, a thin mucky surface layer occurs. The B horizon ranges from loamy fine sand to silty clay loam. It is 10 to 30 inches thick. The solum is 20 to 36 inches thick. The C horizon is fine sand, silt, and very fine sand.

The Colwood soils in Marquette County have a more acid B horizon and higher chroma in the C horizon than is defined in the range for the series. The solum is slightly acid, and the substratum is mildly alkaline. These differences do not alter usefulness or behavior.

Colwood soils have a finer textured B horizon than the Keowns soils. The Colwood soils formed in lacustrine silt and fine sand, whereas the Poygan soils formed in lacustrine silt and clay. All of these soils formed in lacustrine deposits.

Colwood fine sandy loam (0 to 2 percent slopes) (Co).—This soil is in areas that range from broad to long and narrow or irregular in shape.

Included with this soil in mapping are small areas of soils that have a loam and silt loam mineral surface layer. Also included are areas of a soil that has a strongly acid surface layer and subsoil and of a soil that has silt and clay bands in the substratum.

When properly drained and managed this soil is used for most crops commonly grown in the county. Alfalfa is susceptible to winterkill because of wetness. Under a high level of management, continuous row crops can be grown safely. Undrained areas are used for pasture, trees, and wildlife food and cover. (Capability unit IIw–1; woodland group 7; recreation group 3; wildlife group 5b)

Delton Series

The Delton series consists of deep, well-drained, sandy soils that are underlain by silty clay. Ground water is at a depth of more than 5 feet throughout the year. These soils formed under mixed hardwoods in sandy sediments that are 20 to 30 inches thick over clayey sediments.

In a representative profile the surface layer is dark-brown loamy fine sand about 10 inches thick. The subsurface layer is about 6 inches of brown loamy fine sand. The subsoil is dark yellowish-brown, friable loamy fine sand about 14 inches thick in the upper part, reddish-brown sandy loam about 7 inches thick in the middle, and reddish-brown silty clay in the lower part. The substratum is reddish-brown silty clay.

Delton soils have medium available water capacity and low natural fertility. The upper part of the subsoil is moderately rapidly permeable, and the lower part is slowly permeable.

Representative profile of Delton loamy fine sand, 1 to 6 percent slopes, in a cultivated field, SE¼SW¼ sec. 13, T. 16 N., R. 8 E., east of U.S. Highway 51.

Ap—0 to 10 inches, dark-brown (10YR 3/3) loamy fine sand; weak, medium, granular structure; very friable when moist, loose when dry; roots plentiful; strongly acid; abrupt, smooth boundary.
A2—10 to 16 inches, brown (10YR 5/3) loamy fine sand and a few fine pebbles; weak, thick, platy structure; very friable when moist, loose when dry; few plant roots; strongly acid; gradual, wavy boundary.
B1—16 to 30 inches, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) loamy fine sand; very weak, coarse, subangular blocky structure; friable when moist, loose when dry; few plant roots; medium acid; clear, wavy boundary.
B21t—30 to 37 inches, reddish-brown (5YR 4/3 and 4/4) sandy loam; moderate, medium, subangular blocky structure; firm when dry, slightly plastic when wet; few, patchy clay films on ped faces; few plant roots; strongly acid; clear, wavy boundary.
IIB22t—37 to 40 inches, reddish-brown (5YR 4/4) silty clay; moderate, medium, angular blocky structure; very firm, hard, plastic; thin, nearly continuous clay films on ped faces; few plant roots; strongly acid; clear, smooth boundary.
IIC—40 to 62 inches, reddish-brown (5YR 4/4) silty clay; massive stratified silt and clay; hard when dry, plastic when wet; medium acid; many feet thick.

In uncultivated areas the A1 horizon is 2 to 6 inches thick and is very dark brown (10YR 2/2) to black (10YR 2/1). The Ap horizon is loamy sand or fine sandy loam. Depth to the clayey substratum ranges from more than 20 to 40 inches. In places layers of stratified sand and gravel occur in the IIC horizon. The IIC and IIB22t horizons are silty clay loam or silty clay. In places the lower part of the B horizon is slightly mottled. The C horizon is calcareous below a depth of 4 feet in some areas. The hue of the clayey C horizon ranges from 10YR to 2.5YR.

Delton loamy fine sand, 1 to 6 percent slopes (DeB).—This soil is in many areas along the lower boundaries of steep soils. Slopes are less than 300 feet long in most places. Soil areas range from elongated to irregular in shape. The profile of this soil is representative for the series.

Included with this soil in mapping are small areas that are moderately eroded.

This soil is too sloping and droughty for intensive cultivation. It is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded Delton soil and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all crops commonly grown in the county. (Capability unit IIIe–4; woodland group 3; recreation group 5; wildlife group 1)

Delton loamy fine sand, 6 to 12 percent slopes, eroded (DeC2).—This soil is in the uplands, frequently along the lower boundary of steeper soils. Slopes are less than 200 feet long in places. Soil areas are generally elongated to irregular in shape. The profile of this soil is sandy and thinner above the clayey substratum, and its surface layer is thinner and lighter colored than that of the profile described as representative for the series.

Included with this soil are areas of permanent pasture and woods that are generally only slightly eroded.

This soil is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded soil, and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all crops commonly grown in the county. (Capability unit IVe–4; woodland group 3; recreation group 5; wildlife group 1)

Delton fine sandy loam, 0 to 2 percent slopes (DfA).—This soil is on terraces. Some areas are fairly large, but

others are relatively small and are irregular in shape. The profile of this soil has a finer textured surface layer than the profile described as representative for the series.

Included with this soil in mapping are small areas of a soil that has a loam surface layer.

This soil is suited to all crops commonly grown in the county. The soil is slightly droughty because the available water capacity is medium. Maintaining favorable organic-matter content and fertility helps to control erosion and to prevent soil deterioration. (Capability unit IIIs–2; woodland group 1; recreation group 5; wildlife group 1)

Delton fine sandy loam, 2 to 6 percent slopes (DfB).—This soil is along the lower boundaries of steeper soils and on terraces. Slopes are less than 300 feet long in most places. Soil areas range from elongated to irregular in shape. The profile of this soil has a finer textured surface layer than the profile described as representative for the series and a thinner sandy part above the clayey substratum.

Included with this soil in mapping are small areas of a soil that has a loam surface layer. Also included are moderately eroded areas.

This soil is too sloping for intensive cultivation. It is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all crops commonly grown in the county. (Capability unit IIIe–4; woodland group 1; recreation group 5; wildlife group 1)

Delton fine sandy loam, 6 to 12 percent slopes, eroded (DfC2).—Many areas of this soil are along the lower boundaries of steep soils. Slopes are less than 200 feet long in most places. Soil areas are generally elongated to irregular in shape.

The profile of this soil has a thinner, finer textured, lighter colored surface layer than the profile described as representative for the series, and a thinner sandy upper part above the clayey substratum.

Included with this soil in mapping are areas in woods and permanent pasture that are only slightly eroded.

This soil is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IVe–4; woodland group 1; recreation group 5; wildlife group 1)

Fox Series

The Fox series consists of well-drained, loamy soils on outwash benches. These soils are moderately deep to sand and gravel. Ground water is at a depth of more than 5 feet throughout the year. These soils formed under mixed hardwoods in calcareous glacial outwash.

In a representative profile the surface layer is very dark grayish-brown loam about 3 inches thick. The subsurface layer is about 4 inches of light yellowish-brown and yellowish-brown sandy loam. The subsoil is brown loam in the upper 10 inches and strong-brown and yellowish-brown sandy clay loam in the lower 17 niches. The substratum is yellowish-brown, calcareous sand and gravel.

Fox soils have medium water capacity and medium natural fertility. The subsoil is moderately permeable, and the substratum is rapidly permeable.

Representative profile of Fox loam, 2 to 6 percent slopes, in an uncultivated area, NE¼NE¼ sec. 9, T. 14 N., R. 10 E.

A1—0 to 3 inches, very dark grayish brown (10YR 3/2) loam; weak, fine, granular structure; very friable; neutral; clear, smooth boundary.

A21—3 to 5 inches, light yellowish-brown (10YR 6/4) sandy loam; weak, very thin, platy structure, very friable; slightly acid; gradual, wavy boundary.

A22—5 to 7 inches, yellowish-brown (10YR 5/4) sandy loam, weak, fine, subangular blocky structure; very friable; slightly acid; gradual, wavy boundary.

B21t—7 to 17 inches, brown (7.5YR 5/4) loam; weak, medium, subangular blocky structure; friable to firm; clay films on all ped faces; slightly acid; gradual, wavy boundary.

B22t—17 to 29 inches, strong-brown (7.5YR 5/6) sandy clay loam; weak to moderate, medium, subangular blocky structure; firm to friable; clay films on ped faces; medium acid; clear, wavy boundary.

B3—29 to 34 inches, yellowish-brown (10YR 5/6) light sandy clay loam; massive to weak, medium, subangular blocky structure; friable; clay film on all ped faces; medium acid; abrupt, wavy boundary.

C—34 to 60 inches, yellowish-brown (10YR 5/4) sand and gravel; single grained; loose; stratified; moderately alkaline.

The A1 horizon of Fox soils is sandy loam or loam. In cultivated areas the Ap horizon is dark grayish brown (10YR 4/2) and about 8 inches thick. The solum ranges from 20 to 40 inches in thickness but is typically 20 to 34 inches thick. The B22t horizon ranges from sandy clay loam to clay loam. The solum ranges from medium acid to slightly acid.

Fox soils are deeper to calcareous glacial outwash than Casco soils and have a thicker solum. The Fox soils have a finer textured B horizon than the Boyer soils. In most places the Fox soils have a higher dolomitic gravel content in the C horizon than the Boyer and Oshtemo soils. All these soils are underlain by sand or sand and gravel outwash.

Fox sandy loam, 2 to 6 percent slopes (FmB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are irregular in shape. The profile of this soil has a coarser surface layer than that in the profile described as representative for the series.

Included with this soil in mapping are small moderately eroded areas. Also included are small areas of a soil that has a surface layer more than 8 inches thick.

This soil is susceptible to soil blowing and water erosion, and unprotected areas have been damaged by erosion. Eroded areas have a thinner surface soil than uneroded areas and are lower in organic-matter content, fertility, and available water capacity.

This soil is suited to all crops commonly grown in the county. (Capability unit IIIs–4; woodland group 1; recreation group 2; wildlife group 1)

Fox sandy loam, 6 to 12 percent slopes, eroded (FmC2).—The slopes of this soil are less than 200 feet long in most places. Soil areas are generally elongated to irregular in shape. The profile of this soil has a thinner, lighter colored, coarser textured surface layer than the profile described as representative for the series, and a

somewhat thinner surface layer and subsoil (about 30 inches thick).

Included with this soil in mapping are small areas that have slopes of more than 12 percent.

This soil is susceptible to soil blowing and water erosion, and some unprotected areas have been damaged by erosion. Eroded soil has a thinner surface soil than uneroded soil and is lower in organic-matter content, fertility, and available water capacity.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIe–7; woodland group 1; recreation group 2; wildlife group 1)

Fox loam, 2 to 6 percent slopes (FoB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are irregular in shape. The profile of this soil is representative of the series.

Included with this soil in mapping are small areas that are nearly level.

This soil is susceptible to erosion. In some areas that have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIe–2; woodland group 1; recreation group 2; wildlife group 1)

Fox loam, 6 to 12 percent slopes, eroded (FoC2).—The slopes of this soil are less than 300 feet long in most places. Soil areas are irregular in shape. The profile of this soil has a thinner surface layer and subsoil (about 30 inches thick) than the profile described as representative for the series, and a thinner, lighter colored surface layer.

Included with this soil in mapping are areas of complex slopes. Also included are areas in woods and permanent pasture that are only slightly eroded.

This soil is susceptible to erosion. The eroded soil has a thinner surface soil than uneroded soil and is lower in organic-matter content, fertility, and available water capacity.

Crops grow moderately well on this soil under good management. The soil is suited to all crops commonly grown in the county. (Capability unit IIIe–2; woodland group 1; recreation group 2; wildlife group 1)

Gotham Series

The Gotham series consists of deep, well-drained, nearly level to moderately steep sandy soils. These soils formed under grass and oak openings in acid to neutral outwash sand.

In a representative profile the surface layer is very dark grayish brown loamy fine sand about 9 inches thick. The upper part of the subsoil is 11 inches of dark-brown loamy fine sand and loamy sand. The lower part is 10 inches of dark-brown fine sandy loam over strong-brown medium sand. The substratum is brown and yellowish-brown medium and coarse sand.

Gotham soils have rapid permeability, low available water capacity, and low natural fertility.

Representative profile of Gotham loamy fine sand, 0 to 2 percent slopes, in a cultivated area, NW¼NE¼ sec. 36, T. 17 N., R. 9 E.

Ap—0 to 9 inches, very dark grayish brown (10YR 3/2) loamy fine sand; weak, medium, granular structure; very friable; few bleached sand grains; slightly acid; abrupt, smooth boundary.

B11—9 to 15 inches, dark-brown (10YR 4/3) loamy fine sand; weak, fine, subangular blocky structure; very friable; slightly acid; clear, smooth boundary.

B12—15 to 20 inches, dark-brown (7.5YR 4/4) loamy sand; weak, medium, subangular blocky structure; very friable; medium acid; clear, smooth boundary.

B2t—20 to 26 inches, dark-brown (7.5YR 4/4) light fine sandy loam; weak to moderate, medium, subangular blocky structure; clay bridging between particles; very friable; medium acid; clear, smooth boundary.

B3—26 to 30 inches, strong-brown (7.5YR 5/6) coherent medium sand; weak, medium to coarse, subangular blocky structure; very friable; medium acid; gradual, smooth boundary.

C1—30 to 48 inches, brown (7.5YR 5/4) medium sand and a few, fine pebbles; single grained; loose; slightly acid; gradual, smooth boundary.

C2—48 to 60 inches, yellowish-brown (10YR 5/4) medium and coarse sand; single grained; loose; few dark-brown (7.5YR 4/4) sandy loam bands less than 1 inch thick; neutral.

The Ap horizon of Gotham soils is loamy fine sand or fine sandy loam. It ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). The solum is 24 to 36 inches thick. The B2 horizon ranges from loamy fine sand to fine sandy loam. A stony band occurs at a depth of about 24 inches in some areas. In some places thin loamy sand to sandy loam bands are in the sandy C horizon at a depth of 40 to 72 inches. The solum ranges from strongly acid to medium acid. In some areas Gotham soils have a continuous loamy substratum between 40 and 60 inches below the solum.

The Gotham soils are loamy fine sand to fine sandy loam to a greater depth than the Plainfield soils. In most places, Gotham soils formed in finer textured sand than did the Plainfield soils. Gotham soils are underlain by medium acid fine sandy glacial outwash rather than by calcareous glacial outwash as are the Oshtemo soils. All these soils are underlain by sandy outwash in most places.

Gotham loamy fine sand, 0 to 2 percent slopes (GlA).—This soil is on outwash terraces. Many soil areas are fairly large and continuous. The profile of this soil is representative for the series.

Included with this soil in mapping are small areas of poorly drained Granby soils in narrow waterways.

This soil is susceptible to soil blowing, which has removed soil in small areas. The available water capacity of this soil is low.

This soil is suited to all the crops commonly grown in the county. Careful management helps to maintain favorable organic-matter content and fertility. (Capability unit IVs–3; woodland group 4; recreation group 5; wildlife group 3)

Gotham loamy fine sand, 2 to 6 percent slopes (GlB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are normally irregular in shape. The profile of this soil has a slightly thinner surface layer and subsoil (about 26 inches thick) than the profile described as representative for the series.

Included with this soil in mapping are areas of soil underlain by sandstone bedrock at depth of more than 42 inches. Also included are moderately eroded areas.

This soil is droughty and susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IVs–3; woodland group 4; recreation group 5; wildlife group 3)

Gotham loamy fine sand, 6 to 12 percent slopes (GlC).—The slopes of this soil are less than 300 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a thinner combined surface layer and subsoil (about 24 inches thick) than the profile described as representative for the series.

Included with this soil in mapping are areas that are moderately eroded.

The low available water capacity and susceptibility to soil blowing and water erosion severely limit cultivation of this soil. Where unprotected areas have been damaged by erosion, the surface soil is thinner and the available water capacity is lower than in uneroded soil.

This soil is suited to all the crops commonly grown in the county. (Capability unit IVs–3; woodland group 4; recreation group 5; wildlife group 3)

Gotham loamy fine sand, 12 to 20 percent slopes (GlD).—The slopes of this soil are less than 200 feet long in most places. Soil areas are generally elongated to irregular in shape. The profile of this soil has a thinner surface layer and subsoil (about 20 inches thick) than the profile described as representative for the series.

Included with this soil in mapping are soils that are moderately or severely eroded.

This soil is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded soil and the organic-matter content, fertility, and available water capacity are lower.

Included with this soil in mapping are small, complex hilly areas that have severely eroded spots.

This soil is suited to pasture if it has careful management. Complete fertilizers help to maintain this soil. Woodland and wildlife are also suitable uses. (Capability unit VIe–4; woodland group 4; recreation group 5; wildlife group 3)

Gotham loamy fine sand, loamy substratum, 0 to 2 percent slopes (GmA).—This soil is on terraces and in long narrow depressions. Soil areas are normally irregular in shape. The substratum of this soil is loamy at a depth of more than 40 inches.

Included with this soil in mapping are areas of Tedrow loamy fine sand, loamy substratum, that are too small to be mapped separately. Small areas that have loamy soil at a depth of less than 36 inches are also included.

This soil has medium available water capacity and is susceptible to soil blowing. Where soil blowing has occurred, the surface soil is thinner than in uneroded soil and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all crops commonly grown in the county. Maintaining favorable organic-matter content and fertility helps to control erosion and to prevent soil deterioration. (Capability unit IVs–3; woodland group 4; recreation group 5; wildlife group 3)

Gotham loamy fine sand, loamy substratum, 2 to 6 percent slopes (GmB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are generally irregular in shape. This soil has a loamy substratum at depths below 40 inches.

Included with this soil in mapping are areas that have a loamy substratum at a depth of less than 40 inches.

This soil has medium available water capacity and is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner in the uneroded soil and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IVs–3; woodland group 4; recreation group 5; wildlife group 3)

Gotham loamy fine sand, loamy substratum, 6 to 12 percent slopes, eroded (GmC2).—This soil is in the uplands. Slopes are less than 300 feet long in most places. Soil areas are generally irregular in shape. This soil has a loamy substratum at a depth of more than 40 inches. The profile of this soil has a thinner, lighter colored surface layer than the profile described as representative for the series.

Included with this soil in mapping are areas where the loamy substratum is at a depth of less than 40 inches. Also included are areas where the upper part of the profile is similar to that of the coarser textured Plainfield soils. Other inclusions are in woods and permanent pasture where erosion is slight.

This soil has medium available water capacity and is susceptible to soil blowing and water erosion. Unprotected areas have been damaged by erosion. The eroded soil has a thinner surface layer than uneroded soil and lower organic-matter content, fertility, and available water capacity.

This soil is suited to all the crops commonly grown in the county. (Capability unit IVs–3; woodland group 4; recreation group 5; wildlife group 3)

Gotham loamy fine sand, loamy substratum, 12 to 20 percent slopes, eroded (GmD2).—This soil is on hills or ridges. Slopes are less than 300 feet long in most places. Soil areas are generally irregular in shape.

This soil has a loamy substratum at a depth of more than 40 inches. In some areas the loamy substratum occurs at a depth of less than 40 inches. The profile of this soil also has a thinner, lighter colored surface layer than the profile described as representative for the series.

Included with this soil in mapping is a soil similar to the coarser textured Plainfield soils. Also included are slightly eroded areas.

This soil is susceptible to blowing and water erosion, and unprotected areas have been damaged by erosion. Eroded soil has a thinner surface soil than uneroded soil and lower organic-matter content, fertility, and available water capacity.

This soil is suited to pasture where grazing is limited. Complete fertilizers help to maintain these soils. Woodland and wildlife are also suitable uses. (Capability unit VIe–4; woodland group 4; recreation group 5; wildlife group 3)

Gotham fine sandy loam, 0 to 2 percent slopes (GnA).—This soil is on outwash terraces. Soil areas are irregular in shape in most places. Many areas are large and continuous. The profile of this soil has a finer textured surface layer than the profile described as representative for the series. The soil is moderately susceptible to soil blowing.

Gotham fine sandy loam is suited to all the crops commonly grown in the county. Careful management helps to maintain favorable organic-matter content and fertility. (Capability unit IVs–3; woodland group 3; recreation group 5; wildlife group 1)

Gotham fine sandy loam, 2 to 6 percent slopes (GnB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are normally irregular in shape. The profile of this soil has a finer textured surface layer than that of the profile described as representative for the series.

This soil has low available water capacity and is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface layer is thinner than in uneroded soil and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IVs–3; woodland group 3; recreation group 5; wildlife group 1)

Gotham fine sandy loam, loamy substratum, 1 to 3 percent slopes (GoA).—Areas of this soil generally are irregular in shape, and many of them are on terraces between steep soils and the low-lying soils.

This soil has loam in the substratum at a depth of more than 36 inches, and its profile is finer textured in the surface layer than the profile described as representative for the series. The available water capacity is medium.

Included with this soil in mapping are small areas that have a water table at a depth of 3 to 5 feet in wet periods.

This soil is susceptible to water erosion and soil blowing. Where unprotected areas have been damaged by erosion, the surface layer is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IVs–3; woodland group 3; recreation group 5; wildlife group 1)

Granby Series

The Granby series consists of deep, poorly drained, sandy soils on lowland plains and in low-lying drainageways. Ground water is at or near the surface throughout the year. These soils occur at random throughout the county. They formed under native grasses or sedges in nearly neutral sand.

In a representative profile the surfce layer is about 13 inches thick. The upper part is black fine sandy loam, and the lower part is very dark gray loamy fine sand. The subsoil is grayish-brown loamy fine sand about 4 inches thick. The substratum is very pale brown, yellowish-brown, light yellowish-brown, and weak-red loose fine sand that is single grained.

Granby soils have low available water capacity, rapid permeability, and low natural fertility.

Representative profile of Granby fine sandy loam, in uncultivated site, SW¼SW¼ sec. 35, T. 14 N., R. 9 E.

A1—0 to 8 inches, black (10YR 2/1) fine sandy loam; weak, medium, subangular blocky structure; friable; neutral; gradual, smooth boundary.

A3g—8 to 13 inches, very dark gray (10YR 3/1) loamy fine sand; many, fine, faint, dark grayish-brown (10YR 4/2) mottles; weak, medium, platy structure; very friable; neutral; gradual, smooth boundary.

Bg—13 to 17 inches, grayish-brown (10YR 5/2) loamy fine sand; many, fine, prominent, yellowish-brown (10YR 5/6) mottles; weak, medium, platy structure; very friable; neutral; gradual, wavy boundary.

C1—17 to 21 inches, very pale brown (10YR 7/4) fine sand; single grained; loose; mildly alkaline; gradual, wavy boundary.

C2—21 to 27 inches, yellowish-brown (10YR 5/6) fine sand; many, distinct, yellowish-red (5YR 4/8) mottles; single grained; loose; slightly acid; gradual, wavy boundary.

C3—27 to 32 inches, light yellowish-brown (10YR 6/4) fine sand; single grained; loose; moderately alkaline; clear, wavy boundary.

C4—32 to 60 inches, weak-red (2.5YR 5/2) sand; single grained; loose; moderately alkaline.

The A1 horizon of Granby soils is loamy fine sand and fine sandy loam. The C horizon ranges from loamy sand to sand and has a few thin loamy bands. Some areas of Granby soils have a continuous loamy substratum at depths of more than 30 and 60 inches. The C horizon ranges from slightly acid to moderately alkaline.

The Granby soils in Marquette County have higher chromas in the C horizon than is defined in the range for the series, but this does not alter their usefulness or behavior.

Granby soils are underlain by sand, not the very fine sand and silt underlying the Keowns and Colwood soils. Granby soils have a coarser textured solum than the Colwood soils. Keowns and Colwood soils and most areas of Granby soils are formed in lacustrine deposits.

Granby loamy fine sand (0 to 2 percent slopes) (Gr).—Areas of this soil range from broad to long and narrow or irregular in shape. Some areas are large and continuous but others are very small. The profile of this soil has a coarser textured surface layer than the profile described as representative for the series.

Included with this soil in mapping are small gently sloping areas.

Where drained, this soil is susceptible to soil blowing. Where unprotected areas have been damaged by soil blowing, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower. Undrained areas are suitable as woodland and for pasture or wildlife. Drained areas are used for the crops commonly grown in the county. Alfalfa is susceptible to winterkill on these wet soils. (Capability unit IVw–5; woodland group 8; recreation group 3; wildlife group 5b)

Granby fine sandy loam (0 to 2 percent slopes) (Gs).—This soil is in low areas. Areas range from broad to long and narrow or irregular in shape. Some soil areas are large and continuous, but others are very small. The profile of this soil is representative for the series.

Where drained, this soil is susceptible to soil blowing. Where unprotected areas have been damaged by soil blowing, the surface layer is thinner than in uneroded soil and the organic-matter content, fertility, and available water capacity are lower. Undrained areas are suited to pasture, as woodland, or for wildlife habitat. Drained areas are used for most crops commonly grown in the county. Alfalfa is susceptible to winterkill on these wet soils. (Capability unit IVw–5; woodland group 8; recreation group 3; wildlife group 5b)

Granby fine sandy loam, loamy substratum (0 to 2 percent slopes) (Gt).—This soil is in low areas. Areas range

from broad and continuous to long and narrow. Most of them have an irregular pattern in the landscape.

This soil has a loamy substratum at a depth of more than 36 inches. It has medium available water capacity. Included with this soil in mapping are small gently sloping areas.

Unless it is artificially drained, this soil is too wet for cultivation. Drained areas are slightly susceptible to soil blowing. Wind stripcropping and shelterbelts help to control soil blowing. Undrained areas are suited to pasture, trees, or wildlife. Drained areas are suited to the common crops of the county. Alfalfa is susceptible to winterkill on these wet soils. Maintaining favorable organic-matter content and fertility helps to control erosion and to prevent soil deterioration. Undrained areas are used for woodland, wildlife, and pasture. (Capability unit IVw–5; woodland group 8; recreation group 3; wildlife group 5b)

Houghton Series

The Houghton series consists of deep, nearly level soils in lowland areas. Ground water is at or near the surface throughout the year. These soils formed under sedges and reeds and are encroached on by tamarack in places. They formed from decaying vegetative matter.

A representative profile consists of about 108 inches of black mucky peat. The substratum consists of very dark gray mucky peat.

Houghton soils have high available water capacity, moderately rapid permeability, and low natural fertility.

Representative profile of Houghton mucky peat in an uncultivated area, NE¼NE¼ sec. 24, T. 15 N., R. 10 E.

Oa1—0 to 12 inches, black (10YR 2/1) sapric material; few, fine, distinct, yellowish-brown (10YR 5/4) hairline fibers; many roots of living sedges; very friable; slightly acid; gradual, smooth boundary.

Oa2—12 to 108 inches, black (10YR 2/1) sapric material; few hairline fibers give the mass some interlocking stability; very friable; slightly acid; gradual, smooth boundary.

Oa3—108 to 120 inches, very dark gray (N 3/0) sapric material with some indication of sedimentary peat; few quartz grains; friable; slightly acid.

In some areas of Houghton soils, thin layers of fibrous peat occur at random at a depth of more than 24 inches. The depth of the organic soil ranges from 48 inches to about 10 feet.

The Houghton soils have a less acid profile than the Houghton acid variant soils. Houghton soils formed in deep organic materials, but Adrian, Palms, and Rollin soils formed in shallow to moderately deep organic soils over various mineral substrata. These are all associated organic soils.

Houghton mucky peat (0 to 2 percent slopes) (Hm).—This soil is in broad to long and narrow or irregularly shaped areas in lowlands.

Included with this soil in mapping are very small scattered areas that have slopes up to 5 percent.

This soil is susceptible to soil blowing and subsidence where drained. Where drainage is practical, this soil is used for corn and truck crops. Water table control is desirable to prevent unnecessary oxidation and subsidence. (Capability unit IIIw–9; woodland group 10; recreation group 1; wildlife group 6)

Houghton Series, Acid Variant

The Houghton series, acid variant, consists of deep, organic soils in relatively small level depressions or basins. Ground water is at or near the surface throughout the year. These soils formed from decaying fibrous plant residues under sedges and fibrous plants that were encroached on by sphagnum moss and bog blueberry.

In a representative profile the surface layer is extremely acid peat about 24 inches thick. Between depths of 24 and 72 inches is black, extremely acid mucky peat.

These soils have very high available water capacity, moderate permeability, and very low natural fertility.

Representative profile of Houghton peat, acid variant, in an undisturbed area, NE¼NE¼ sec. 36, T. 17 N., R. 9 E.

Oe—0 to 24 inches, very dark brown (10YR 2/2) hemic material, common, fine, distinct, yellowish-brown (10YR 5/4) fibrous sedge materials; very friable; extremely acid; gradual, smooth boundary.

Oa—24 to 72 inches, black (10YR 2/1) sapric material, few, fine, distinct, yellowish-brown fibrous sedge materials; very friable; very strongly acid.

A few layers of fibrous peat occur at random at a depth of more than 24 inches. The Oe horizon ranges from very dark brown (10YR 2/2) to black (N 2/0).

Living sphagnum moss covers the surface of Houghton peat, acid variant. In most places the outer margins are not covered with sphagnum moss but have a cover of sedges and grasses. The organic deposits extend from a depth of 60 inches to about 10 feet.

This acid soil has a more acid profile than the associated Houghton soils.

Houghton peat, acid variant (0 to 2 percent slopes) (Hp).—This soil is in small, isolated, rounded to irregularly shaped nearly level depressions in low areas.

Because of its small area, its difficulty to drain, and its extreme acidity, this soil is suited only to wildlife habitat or nature study areas. (Capability unit VIIw–10; woodland group 10; recreation group 1; wildlife group 6)

Keowns Series

The Keowns series consists of poorly drained, loamy soils in nearly level lake basins and near long, narrow drainageways. Ground water is at or near the surface throughout the year. Keowns soils formed under lowland hardwoods and wetland grasses and sedges. They formed in neutral to moderately alkaline glaciolacustrine silt and fine sand.

In a representative profile the surface layer is black fine sandy loam about 9 inches thick. The subsoil is 11 inches of dark grayish-brown and grayish-brown fine sandy loam over 4 inches of light yellowish-brown silt loam. The substratum is stratified grayish-brown silt and light olive-brown fine sand.

Keowns soils have medium available water capacity, moderate permeability, and low natural fertility.

Representative profile of Keowns fine sandy loam in a cultivated field, SW¼SE¼ sec. 26, T. 17 N., R. 9 E.

Ap—0 to 9 inches, black (10YR 2/1) fine sandy loam; moderate, medium to fine, granular structure; very friable; neutral; abrupt, smooth boundary.

B1g—9 to 12 inches, dark grayish-brown (2.5Y 4/2) fine sandy loam; weak, medium, subangular blocky structure; very friable; mildly alkaline; clear, wavy boundary.

B2g—12 to 20 inches, grayish-brown (2.5Y 5/2) fine sandy loam; few fine, distinct, brown (7.5YR 4/4) and grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; very friable; mildly alkaline; gradual, wavy boundary.

B3g—20 to 24 inches, light yellowish-brown (2.5Y 6/4) silt loam; many, medium, prominent, yellowish-brown (10YR 5/8) mottles; very weak, coarse, prismatic structure; friable; mildly alkaline; clear, wavy boundary.

Cg—24 to 60 inches, stratified grayish-brown (2.5Y 5/2) silt and light olive-brown (2.5Y 5/4) fine sand; moderately alkaline.

The C horizon ranges from neutral to moderately alkaline. In most places the Keowns soils in Marquette County are outside the range for the series, because they lack carbonates to a depth of 20 inches and have a chroma of 3 or more between depths of 9 and 30 inches, but this does not alter their usefulness or behavior.

The Keowns soils lack the well-developed textural B horizon of the Colwood soils. Keowns soils developed in stratified silt and fine sand rather than in sand alone as did the Granby soils. The ground water table is higher in the Keowns soils than in the somewhat poorly drained Yahara soils, and there is more gleying in the profile. All of these soils formed in lacustrine deposits.

Keowns fine sandy loam (0 to 2 percent slopes) (Ke).—This soil is in low areas. Soil areas range in shape from broad or irregular to long and narrow.

Included with this soil in mapping are small gently sloping areas. Also included are areas where the surface layer is loam or silt loam.

Wetness is the principal limitation to cultivation. If adequate drainage is provided, this soil is used for most of the crops commonly grown in the county. Alfalfa is susceptible to winterkill on these wet soils. (Capability unit IVw–5; woodland group 7; recreation group 3; wildlife group 5b)

Lapeer Series

The Lapeer series consists of deep, well-drained, nearly level to steep loamy soils in upland glacial till areas. Ground water is at a depth of more than 5 feet throughout the year. These soils formed under mixed hardwoods in calcareous sandy loam glacial till.

In a representative profile the surface layer is very dark brown fine sandy loam about 3 inches thick. The subsurface layer is about 10 inches of brown fine sandy loam. The subsoil is brown sandy loam about 12 inches thick in the upper part. The lower part is brown sandy clay loam over dark yellowish-brown sandy loam, and is 10 inches thick. The substratum is yellowish-brown gravelly sandy loam.

Lapeer soils have medium available water capacity, moderate permeability, and medium natural fertility.

Lapeer soils occur only in complexes with Pardeeville soils in Marquette County.

Representative profile of Lapeer fine sandy loam in an area of Lapeer-Pardeeville fine sandy loams, 2 to 6 percent slopes, in a wooded area, NE¼NW¼ sec. 36, T. 14 N., R. 10 E.; 10 feet east of County Road in road cut.

A1—0 to 3 inches, very dark brown (10YR 2/2) fine sandy loam; weak, fine, granular structure; very friable; neutral; clear, smooth boundary.

A2—3 to 13 inches, brown (10YR 4/3) fine sandy loam; weak, medium, platy structure; very friable; slightly acid; clear, wavy boundary.

B1—13 to 15 inches, brown (7.5YR 4/4) sandy loam; weak, fine, subangular blocky structure; very friable; medium acid; clear, wavy boundary.

B21t—15 to 25 inches, brown (7.5YR 4/4) heavy sandy loam; moderate, fine, subangular blocky structure; thin, patchy clay films; friable; medium acid; clear, wavy boundary.

B22t—25 to 33 inches, brown (7.5YR 4/4) light sandy clay loam; moderate, medium, subangular blocky structure; slightly firm; thin, patchy clay films; medium acid; clear, wavy boundary.

B3—33 to 35 inches, dark yellowish-brown (10YR 4/4) sandy loam; weak, medium, subangular blocky structure; very friable; slightly acid; clear, wavy boundary.

C2—35 to 60 inches, yellowish-brown (10YR 5/4) gravelly sandy loam; massive; very friable; moderately alkaline.

In cultivated areas the Ap horizon is dark grayish brown and about 8 inches thick. Depth to the underlying unweathered glacial till ranges from 24 to 36 inches. The B2 horizon ranges from sandy clay loam to clay loam. The C horizon ranges from loamy fine sand to fine sandy loam. Stoniness is common in these soils.

The Lapeer soils have a thicker, finer textured B2 horizon than the Mecan soils and a more abrupt B3 horizon. Also, Lapeer soils are shallower to the calcareous glacial till than the Mecan soils. The dolomitic gravel content of the C horizon of the Lapeer soils is higher than that of the Mecan soils. The unweathered glacial till of the Lapeer soils generally is 10YR in hue, but in the Mecan soils the till is redder (7.5YR hue) in most places. Lapeer soils are lighter colored than the Pardeeville soils and have a finer textured solum. All of these soils formed in calcareous glacial till.

Lapeer-Pardeeville fine sandy loams, 2 to 6 percent slopes (LpB).—These soils are surrounded by soils of steeper ridges or hills. The soil areas are normally irregular to rounded, and areas are up to ¾ mile long and ¼ mile wide. Many smaller areas also occur. Soil slopes are irregular, and most of them are less than 300 feet long. The profiles of these soils have been described in the Lapeer and Pardeeville series descriptions.

Included with these soils in mapping are nearly level areas. Also included are areas of Gotham and Plainfield soils too small to be mapped separately. In some areas soils that have a loam surface and soils that are moderately eroded are included.

Erosion is the principal hazard to cultivation of these soils. The soils are suited to all crops commonly grown in the county. Liming increases the growth of legumes. (Capability unit IIIe–4; woodland group 1; recreation group 2; wildlife group 1)

Lapeer-Pardeeville fine sandy loams, 6 to 12 percent slopes, eroded (LpC2).—These soils are on the tops and sides of hills or ridges. In most places areas are elongated and less than ½ mile long and 400 feet wide. The slopes cross the narrow width of the soil areas and are less than 300 feet long in most places. The profiles of these soils have a somewhat thinner lighter colored surface layer and a somewhat thinner subsoil than in the profiles described as representative for the series.

Included with these soils in mapping are soils that have a loam surface layer. Permanent pasture or woods are generally in areas only slightly eroded.

The major hazard to cultivation is erosion. In some places moderate erosion has removed some of the surface soil. In these areas the organic-matter content, fertility, and available water capacity are lower than in uneroded areas. In some areas small gullies have formed.

These soils are suited to all the crops commonly grown in the county. (Capability unit IVe–4; woodland group 1; recreation group 2; wildlife group 1)

Lapeer-Pardeeville fine sandy loams, 12 to 20 percent slopes, eroded (LpD2).—These soils are on the tops and sides of hills and ridges. In most places areas are somewhat elongated. They are about one-fourth mile long and less than 500 feet wide. Slopes cross the narrow width of these areas and are generally less than 200 feet long.

The profiles of these soils have thinner, lighter colored surface layers than those described in the representative profiles. In some areas the underlying soil layers are thinner than those described.

Included with these soils in mapping are small severely eroded areas. Also included are areas of permanent pasture and woods that are only slightly eroded. Some included areas have a loam surface layer.

The major hazard to cultivation of these soils is erosion. In some areas moderate erosion has removed some of the surface soil. In these areas the organic-matter content, fertility, and available water capacity are lower than in uneroded areas.

These soils have medium available water capacity, are severely susceptible to water erosion, and are subject to gullying if not protected. They are better suited to pasture, woodland, and wildlife than to crops. If used to produce forage, they need not be renovated more than once each 5 years. Controlled grazing and a good fertility program help to maintain these soils. (Capability unit VIe–4; woodland group 1; recreation group 2; wildlife group 1)

Lapeer-Pardeeville fine sandy loams, 20 to 30 percent slopes, eroded (LpE2).—These soils are on tops and sides of hills or ridges. Areas are elongated and up to one-fourth mile long and 500 feet wide. Slopes cross the narrow width of these areas and are generally less than 200 feet long.

The profiles of these soils have a thinner, lighter colored surface layer and somewhat thinner individual soil layers than those in the profiles described as representative for the series.

Included with these soils in mapping are areas in permanent pasture and woods that are only slightly eroded. Also included are areas that have a loam surface layer. Other inclusions are local areas where slopes are more than 30 percent.

The major hazard to cultivation of these soils is erosion. The soils are too steep to be used safely for cultivated crops. In some areas gullies have formed. Erosion has removed some of the surface soil, and this has lowered the organic-matter content, fertility, and available water capacity.

These soils are more suitable for pasture, as woodland, or for wildlife habitat than for other uses. (Capability unit VIIe–4; woodland group 1; recreation group 2; wildlife group 1)

Lorenzo Series

The Lorenzo series consists of nearly level to gently sloping, loamy soils. These soils formed under native grasses and are shallow over calcareous glacial outwash sand and gravel.

In a representative profile the surface layer is very dark brown loam about 8 inches thick. The subsoil extends to a depth of 19 inches. The upper 3 inches is dark-brown loam, the middle 4 inches is dark-brown sandy clay loam, and the lower 4 inches is dark-brown gravelly sandy loam. The substratum is yellowish-brown cobbly and gravelly sand.

Lorenzo soils have low available water capacity, moderate permeability, and low natural fertility.

Representative profile of Lorenzo loam, 0 to 2 percent slopes, in a cultivated field, NW¼SE¼ sec. 26, T. 14 N., R. 10 E.

Ap—0 to 8 inches, very dark brown (10YR 2/2) loam; visible white quartz grains; weak, coarse, blocky structure; friable; medium acid; abrupt, smooth boundary.

B21t—8 to 11 inches, dark-brown (7.5YR 4/2) loam; weak to moderate, medium, subangular blocky structure; peds coated with very dark brown (7.5YR 3/2); friable; medium acid; clear, wavy boundary.

B22t—11 to 15 inches, dark-brown (7.5YR 4/2) sandy clay loam; moderate, medium, subangular blocky structure; clay films common; slightly firm; many nonlimy pebbles; medium acid; clear, wavy boundary.

B3—15 to 19 inches, dark-brown (7YR 4/2) gravelly sandy loam; weak, coarse, subangular blocky structure; very friable; medium acid; clear, wavy boundary.

C—19 to 60 inches, yellowish-brown (10YR 5/4) cobbly and gravelly sand outwash; single grained; loose; calcareous.

The Ap horizon is very dark brown (10YR 2/2) or black (10YR 2/1). The solum ranges from 12 to 24 inches in thickness. The B2 horizon ranges from loam to sandy clay loam.

Lorenzo soils have a thicker, darker colored A1 horizon and a slightly coarser textured B1 horizon than do the otherwise similar Casco soils. Both soils are underlain by sand and gravel outwash.

Lorenzo loam, 0 to 2 percent slopes (LrA).—Areas of this soil are generally broad and irregular in shape. The profile of this soil is representative for the series.

Included with this soil in mapping are areas that have a fine sandy loam surface layer.

This soil is used for all the crops commonly grown in the county. Maintaining favorable organic-matter content and fertility helps to control erosion and to prevent soil deterioration. (Capability unit IIIs–4; woodland group 12; recreation group 2; wildlife group 4)

Lorenzo loam, 2 to 6 percent slopes (LrB).—This loamy, gently sloping soil is on terraces. The slopes are less than 300 feet long in most places. The profile of this soil has a slightly thinner surface layer and subsoil (about 15 inches thick) than the profile described as representative for the series.

Included with this soil in mapping are moderately eroded areas. Also included are local areas that have a fine sandy loam surface layer.

The main hazard to cultivating this soil is erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIe–4; woodland group 12; recreation group 2; wildlife group 4)

Marsh

Marsh consists of low areas that are flooded most of the time. It is in small depressions and very low areas along lakes and streams.

Marsh (Ma).—This land type is covered with cattails and marsh grasses in most places. Some areas are floating bogs that consist of less than 24 inches of organic soil. Artificial drainage is very difficult because of the position of Marsh.

This mapping unit is better suited to wildlife and recreation than to other uses. (Capability unit VIIIw–15; woodland group 11; recreation group 1; wildlife group 5b)

Mecan Series

The Mecan series consists of deep, well-drained, gently sloping to steep soils that have a sandy loam subsoil. Ground water is at a depth of more than 5 feet throughout the year. These soils formed under mixed hardwoods in calcareous light sandy loam to loamy sand glacial till (fig. 6).

In a representative profile the surface layer is dark-brown loamy fine sand about 4 inches thick. The subsurface layer is brown loamy fine sand about 8 inches thick. The upper part of the subsoil is reddish-brown light sandy loam over dark reddish-brown sandy loam. It is 15 inches thick. The lower part is dark reddish-brown sandy loam over reddish-brown sandy loam and is 20 inches thick. The substratum is brown loamy sand.

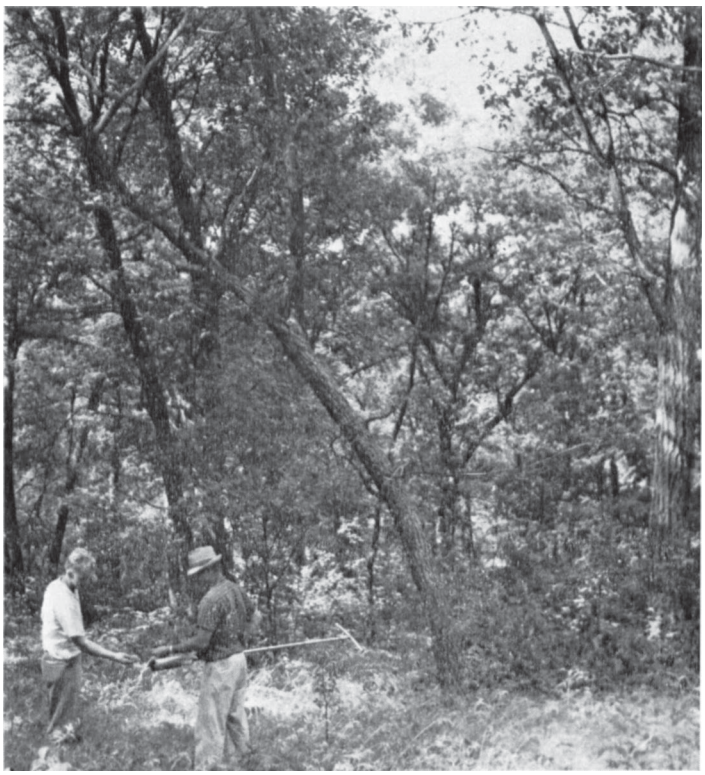

Figure 6.—Mixed oak woodland on Mecan loamy fine sand.

Mecan soils have low available water capacity, moderately rapid permeability, and low natural fertility.

Representative profile of Mecan loamy fine sand, 12 to 20 percent slopes, in an uncultivated field, SE¼SE¼ sec. 24, T. 17 N., R. 9 E.; 300 yards south of County Road Y, and 100 feet west of unnamed road on the east section line.

A1—0 to 4 inches, dark-brown (10YR 4/3) loamy fine sand; weak, fine, granular structure; very friable; roots plentiful; medium acid; abrupt, smooth boundary.

A2—4 to 12 inches, brown (7.5YR 5/4) loamy fine sand; single grained to weak, medium, platy structure; very friable; roots plentiful; medium acid; clear, wavy boundary.

B1t—12 to 18 inches, reddish-brown (5YR 4/4) light sandy loam; weak, fine, subangular blocky structure; very friable; roots plentiful; slightly acid; clear, wavy boundary.

B21t—18 to 27 inches, dark reddish-brown (5YR 3/4) heavy sandy loam; moderate, medium, subangular blocky structure; firm, slightly plastic; roots plentiful; common thin clay films on ped faces; slightly acid; gradual, wavy boundary.

B22t—27 to 32 inches, dark reddish-brown (5YR 3/4) heavy sandy loam; moderate, fine, subangular blocky structure; friable; some organic stains on ped faces; few dolomitic cobblestones; roots plentiful; common thin clay films on ped faces; neutral; clear, wavy boundary.

B3t—32 to 47 inches, reddish-brown (5YR 4/4) sandy loam, weak, medium, subangular blocky structure; very friable; few dolomitic rocks and cobblestones; few plant roots; thin clay bridging of sand grains; neutral; gradual, wavy boundary.

C—47 to 60 inches, brown (7.5YR 5/4) heavy loamy sand; single grained; loose; mildly alkaline in upper part but moderately alkaline with increase in depth.

A1 horizon of Mecan soils is loamy fine sand or fine sandy loam. In some undisturbed areas, there is a thin (less than 4 inches thick) black (10YR 2/1) A1 horizon. The depth to the unweathered glacial till ranges from 40 to 60 inches. The B2 horizon ranges from sandy loam to sandy clay loam. Less than one-half of the total B horizon is sandy clay loam. The C horizon ranges from fine sand to sandy loam. Some areas are stony.

The Mecan soils have a coarser textured B2 horizon than the associated Lapeer soils and a thicker, coarser textured B3 horizon. Mecan soils are deeper to the calcareous glacial till than are the Lapeer soils. The dolomitic gravel content of the C horizon of the Mecan soils is lower than that of the Lapeer soils. Mecan soils have a thicker solum (more than 36 inches thick) than the associated Wyocena soils and are underlain by more coherent calcareous glacial till.

Mecan loamy fine sand, 12 to 20 percent slopes, eroded (McD2).—This soil is on sides and tops of hills and ridges. Soil areas are elongated to irregular in shape. Slopes are less than 200 feet long in most places.

The profile of this soil is representative for the series.

Included with this soil in mapping are areas of woods and permanent pasture that are only slightly eroded. Also included are areas that have a fine sandy loam surface layer.

In eroded soils, the surface soil is not so thick as in uneroded areas and organic-matter content, fertility, and available water capacity are lower. Gullies have formed in places.

This soil is too steep to be safely used for cultivation. It is better suited to pasture that has only limited grazing and is renovated not more than once every 5 years. Woodland and wildlife also are suitable uses. (Capability unit VIe–4; woodland group 3; recreation group 5; wildlife group 3)

Mecan loamy fine sand, 20 to 30 percent slopes, eroded (McE2).—This soil is on top slopes and side slopes of hills and ridges. The slopes are less than 200 feet long in most places. Soil areas are generally somewhat elongated to rounded in shape.

The profile of this soil has a thinner, lighter colored surface layer than the profile described as representative for the series. In many places this soil has thinner individual layers and the profile is not deeply developed. In some places this soil is underlain by limestone bedrock at a depth of less than 5 feet.

In some areas erosion has decreased the thickness of the surface soil. This is caused by overgrazing of pasture or woodland or by cultivating areas that are too steep to be safely cultivated. In these areas the organic-matter content, fertility, and available water capacity are lower than in the uneroded areas. Some gullying has occurred.

This soil is better suited as woodland and for wildlife habitat. It is also suited to pasture that has very limited grazing and careful management. (Capability unit VIIe–4; woodland group 3; recreation group 5; wildlife group 3)

Mecan fine sandy loam, 2 to 6 percent slopes (MeB).—This soil is in areas only a few acres in size on ridgetops and on foot slopes of relatively steep ridges. Soil areas are elongated to irregular and rounded in shape. The profile of this soil has a finer textured surface layer than the profile described as representative for the series. In some places this soil has silt and clay in the substratum.

This soil is slightly susceptible to erosion. It is suited to all the crops commonly grown in the county. (Capability unit IIIe–4; woodland group 3; recreation group 5; wildlife group 1)

Mecan fine sandy loam, 6 to 12 percent slopes, eroded (MeC2).—This soil is generally in areas only a few acres in size. These areas are elongated to irregular in shape. The soil is on tops and sides of hills and ridges. Slopes are less than 300 feet long in most places.

The profile of this soil has a finer textured, thinner surface layer than the profile described as representative for the series. The individual layers also are somewhat thinner. Where erosion has reduced the thickness of the original surface soil, the organic-matter content, fertility, and available water capacity are lower than in uneroded soils.

Included with this soil in mapping are areas of woods and permanent pasture that are only slightly eroded. Also included are small areas of complex rolling slopes.

This soil is too steep to be used safely for intensive cultivation. Unprotected areas now cropped are being damaged by erosion.

This soil is suited to all the crops commonly grown in the county. (Capability unit IVe–4; woodland group 3; recreation group 5; wildlife group 1)

Metea Series

The Metea series consists of deep, well-drained, nearly level to moderately steep, loamy and sandy soils on glacial till. Ground water is at a depth of more than 5 feet throughout the year. These soils formed under mixed hardwoods in sandy eolian deposits over calcareous glacial drift.

In a representative profile the surface layer is very dark brown fine sandy loam about 4 inches thick. The subsurface layer is 17 inches of brown loamy fine sand. The upper part of the subsoil is dark-brown loamy fine sand about 3 inches thick. The lower part is dark-brown sandy clay loam and dark-brown loam 19 inches thick. The substratum is brown sandy loam.

Metea soils have medium available water capacity, moderate permeability, and low to medium natural fertility.

Representative profile of Metea fine sandy loam, 6 to 12 percent slopes, in an uncultivated area, NE¼SW¼ sec. 3, T. 14 N., R. 8 E.

A1—0 to 4 inches, very dark brown (10YR 2/2) fine sandy loam; weak, fine, granuular structure; very friable; mildly alkaline; clear, wavy boundary.

A2—4 to 21 inches, brown (7.5YR 5/4) loamy fine sand; weak, subangular blocky structure; friable; neutral; abrupt, wavy boundary.

B21t—21 to 24 inches, dark-brown (7.5YR 4/4) loamy fine sand; medium, fine, blocky structure; clay bridging between sand grains; neutral; gradual, wavy boundary.

IIB22t—24 to 40 inches, dark-brown (7.5YR 4/4) light sandy clay loam; strong, medium, blocky structure; clay films on all ped faces; friable; slightly acid; abrupt, wavy boundary.

IIB3—40 to 43 inches, dark-brown (7.5YR 4/4) loam; moderate, medium and fine, blocky structure; friable; mildly alkaline; clear, wavy boundary.

IIC—43 to 60 inches, brown (7.5YR 5/4) sandy loam; weak, medium, platy structure; friable; moderately alkaline.

The A1 horizon of Metea soils is loamy fine sand or fine sandy loam. In cultivated areas the A1 horizon is about 8 inches thick. Depth to the unweathered glacial till ranges from 42 inches to 54 inches. The B2 horizon ranges from loam to clay loam or silty clay loam.

In some areas of Metea soils, the finer textured lower part is thin and is underlain by fine sand but the entire solum is above the fine sand. The soil in these areas has been named a sandy substratum phase.

The upper part of the Metea subsoil is coarser textured and the lower part is finer textured than in the associated Lapeer soils. The lower part of the Metea subsoil is finer textured than the substratum of the associated Gotham loam.

Metea loamy fine sand, 2 to 6 percent slopes (MfB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a thicker, coarser textured surface layer and a thicker sandy layer above the subsoil than the profile described as representative for the series.

Included with this soil in mapping are areas that are moderately eroded.

This soil is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded soil and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIe–7; woodland group 4; recreation group 5; wildlife group 3)

Metea loamy fine sand, 6 to 12 percent slopes, eroded (MfC2).—The slopes of this soil are less than 200 feet long in most places. Soil areas are generally irregular in shape.

The profile of this soil has a slightly thicker, sandy upper part above the subsoil than the profile described as representative of the series and a thinner, lighter colored, coarser textured surface layer.

Included with this soil in mapping are areas of woods and permanent pasture that are only slightly eroded. Also included are local areas that are severely eroded.

This soil is susceptible to soil blowing and moderate water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIe–7; woodland group 4; recreation group 5; wildlife group 3)

Metea loamy fine sand, 12 to 20 percent slopes (MfD).—The slopes of this soil are less than 200 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a coarser textured surface layer and a thinner sandy layer above the subsoil than the profile described as representative for the series.

Included with this soil in mapping are small areas that have a fine sandy loam surface layer. Also included are small moderately eroded areas.

This soil is susceptible to severe water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all crops commonly grown in the county but is better suited to hay or pasture than to cultivated crops. Woodland and wildlife are also suitable uses. (Capability unit IVe–7; woodland group 4; recreation group 5; wlidlife group 3)

Metea loamy fine sand, sandy substratum, 2 to 6 percent slopes (MlB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are generally irregular in shape. This soil has a coarser textured surface layer than the profile described as representative for the series and contains more sand in the substratum. In some places the sandy layer above the subsoil is more than 17 inches thick.

Included with this soil in mapping are moderately eroded areas.

This soil is susceptible to soil blowing and water erosion. Where erosion has reduced the thickness of the surface soil, the organic-matter content, fertility, and available water capacity are lower than in uneroded soil.

This soil is suited to all crops commonly grown in the county. (Capability unit IIe–7; woodland group 4; recreation group 5, wildlife group 3)

Metea loamy fine sand, sandy substratum, 6 to 12 percent slopes, eroded (MlC2).—The slopes of this soil are less than 200 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a thinner, lighter colored, coarser textured surface layer than the profile described as representative for the series and contains more sand in the substratum.

Included with this soil in mapping are areas in woods and permanent pasture that are slightly eroded.

This soil is susceptible to soil blowing and moderate water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than the uneroded soil and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIe–7; woodland group 4; recreation group 5; wildlife group 3)

Metea fine sandy loam, 2 to 6 percent slopes (MmB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a thicker surface layer and subsoil (about 45 inches thick) than the profile described as representative for the series.

Included with this soil in mapping are small areas of nearly level soils and soils that have complex slopes. Also included are areas that are moderately eroded. Some areas are finer textured in the middle part of the subsoil than the representative soil.

This soil is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded soil and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIe–7; woodland group 3; recreation group 5; wildlife group 1)

Metea fine sandy loam, 6 to 12 percent slopes (MmC).—The slopes of this soil are less than 500 feet long in most places, and they cross the narrow width of elongated or irregularly shaped areas. The profile of this soil is representative for the series.

Included with this soil in mapping are small areas that have complex rolling slopes and areas of Lapeer and Gotham soils. Also included are areas that are moderately eroded. Some areas are finer textured in the middle part of the subsoil than the representative soil.

This soil is susceptible to soil blowing and water erosion. Unprotected areas are damaged by erosion. This erosion reduces the thickness of the surface soil and the organic-matter content, fertility, and available water capacity.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIe–7; woodland group 3; recreation group 5; wildlife group 1)

Metea fine sandy loam, 12 to 20 percent slopes, eroded (MmD2).—The slopes of this soil are less than 200 feet long in most places. Soil areas are generally elongated or irregular in shape. The profile of this soil has a thinner, lighter colored surface layer than the profile described as representative of the series and a thinner sandy layer (about 13 inches thick) above the subsoil.

Included with this soil in mapping are areas in permanent pasture and woods that are only slightly eroded.

This soil is susceptible to severe water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded soil, and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county, but it is better suited to pasture and hay than to row crops. (Capability unit IVe–7; woodland group 3; recreation group 5; wildlife group 1)

Metea fine sandy loam, sandy substratum, 2 to 6 percent slopes (MnB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are generally irregular in shape. The substratum of this soil contains

more sand than that under the representative soil. In places the sandy subsurface layer is more than 17 inches thick.

Included with this soil in mapping are small moderately eroded areas.

Where erosion has reduced the thickness of the surface soil, the organic-matter content, fertility, and available water capacity are lower than in the uneroded soil.

This soil is suited to all the crops commonly grown in the county (fig. 7). (Capability unit IIe–7; woodland group 3; recreation group 5; wildlife group 1)

Metea fine sandy loam, sandy substratum, 6 to 12 percent slopes, eroded (MnC2).—The slopes of this soil are less than 200 feet long in most places. Soil areas are generally irregular in shape. This soil has a thinner, lighter colored surface layer and the substratum contains more sand at a depth of 42 to 54 inches than the representative soil.

Included with this soil in mapping are areas in permanent pasture and woods that are only slightly eroded. Also included are stony areas.

This soil is susceptible to soil blowing and moderate water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded soil and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIe–7; woodland group 3; recreation group 5; wildlife group 1)

Metea fine sandy loam, stratified substratum, 0 to 2 percent slopes (MoA).—This soil is in valleys between upland hills or ridges. It has a dark-colored surface layer in some places. The profile of this soil has a somewhat thicker sandy upper part above the subsoil than the profile described as representative of the series and has a stratified silt and sand substratum. In places, the surface layer is more than 4 inches thick. The available water capacity is high.

This soil is used for all crops commonly grown in the county. It is susceptible to soil blowing. Where blowing has reduced the thickness of the surface soil, the organic-matter content, fertility, and available water capacity are lower than in the uneroded soil. (Capability unit IIs–7; woodland group 3; recreation group 5; wildlife group 1)

Figure 7.—Alfalfa on Metea fine sandy loam, sandy substratum, 2 to 6 percent slopes.

Metea fine sandy loam, stratified substratum, 2 to 6 percent slopes (MoB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are elongated to irregular in shape. The profile of this soil has a somewhat thicker sandy layer above the subsoil than the profile described as representative of the series and has a stratified silt and fine sand substratum.

Included with this soil in mapping are small areas that are moderately eroded.

This soil is susceptible to soil blowing and water erosion. It is slightly droughty. Where areas have been damaged by erosion, the surface soil is thinner than in uneroded soil and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all crops commonly grown in the county. (Capability unit IIe–7; woodland group 3; recreation group 5; wildlife group 1)

Metea fine sandy loam, stratified substratum, 6 to 12 percent slopes (MoC).—The slopes of this soil are less than 200 feet long in most places. Soil areas are generally irregular in shape. This soil has a stratified silt and fine sand substratum.

Included with this soil in mapping are small areas that are moderately eroded.

This soil is susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIe–7; woodland group 3; recreation group 5; wildlife group 1)

Montello Series

The Montello series consists of deep, moderately well drained, nearly level and gently sloping, loamy soils on lake-laid plains. These soils formed under native grasses and widely spaced mixed hardwoods in calcareous lacustrine silt and clay.

In a representative profile the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is about 4 inches of very dark grayish brown silt loam. The upper part of the subsoil is about 9 inches thick and consists of dark-brown silty clay loam over dark reddish-brown silty clay. The lower part is dark-brown and brown silty clay loam about 15 inches thick. The substratum is brown silty clay loam.

Montello soils have high available water capacity, moderately slow permeability, and high natural fertility.

Representative profile of Montello silt loam, 0 to 2 percent slopes, in a cultivated area, NW¼NW¼ sec. 28, T. 15 N., R. 8 E.; 50 feet west of Town Road A and three-fifths mile south of intersection of Town Roads A and D.

Ap—0 to 8 inches, very dark brown (10YR 2/2) silt loam; moderate, medium and fine, subangular blocky structure; friable; neutral; clear, smooth boundary.

A3—8 to 12 inches, very dark grayish-brown (10YR 3/2) heavy silt loam; moderate, medium, platy structure in upper part and weak, moderate, subangular blocky near the lower boundary; firm; neutral; clear, wavy boundary.

B1t—12 to 16 inches, dark-brown (7.5YR 4/4) light silty clay loam; moderate, medium, subangular blocky structure; hard when dry, plastic when wet; slightly acid; clear, wavy boundary.

B21t—16 to 21 inches, reddish-brown (5YR 4/3) and dark reddish-brown (5YR 3/4) light silty clay; moderate, fine, subangular blocky structure; hard when dry, plastic when wet; thick continuous clay films on all ped faces; slightly acid; gradual, wavy boundary.

B22t—21 to 26 inches, dark-brown (5YR 4/4) heavy silty clay loam; common, fine, distinct, strong-brown (7.5YR 5/6) mottles near the lower boundary; moderate, fine, subangular blocky structure; hard when dry, plastic when wet; thin to moderately thick and continuous clay films on most ped faces; slightly acid; gradual, wavy boundary.

B3—26 to 36 inches, brown (7.5YR 5/4) silty clay loam; many fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; hard when dry, plastic when wet; strong effervescence; gradual, smooth boundary.

Cca—36 to 50 inches, brown (7.5YR 5/4) light silty clay loam; massive; firm; soft fine lime segregations; moderately alkaline; violent effervescence.

In places thin sandy strata occur throughout the profile. A cap of silt or loamy outwash less than 18 inches thick overlies the water-laid sediments in local areas. The B2t horizon ranges from silty clay loam to silty clay. The C horizon generally has a hue of 7.5YR, but hue ranges from 10YR to 5YR. The C horizon is generally calcareous; it is alkaline to neutral.

Montello soils have darker colored surface soil than the associated Briggsville soil and a more mottled subsoil that has lower chroma.

Montello loam, 0 to 2 percent slopes (MrA).—This soil is adjacent to low areas. Its profile has a coarser textured loam surface layer than the profile described as representative for the series.

This soil dries slowly in the spring and after heavy rains. Surface drainage that speeds runoff is beneficial.

This soil is suited to all the crops commonly grown in the county. Where erosion is controlled and soil deterioration is prevented, continuous row crops can be grown. (Capability unit IIs–7; woodland group 12; recreation group 6; wildlife group 2)

Montello loam, 2 to 6 percent slopes (MrB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are generally irregular in shape. This soil has slightly better drainage than Montello loam, 0 to 2 percent slopes, because runoff from the gentle slopes is faster.

Included with this soil in mapping are areas that are moderately eroded.

The main hazard to cultivation is erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content and fertility are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIe–6; woodland group 12; recreation group 6; wildlife group 2)

Montello silt loam, 0 to 2 percent slopes (MsA).—This soil is adjacent to low areas. It has the profile described as representative for the series.

This soil dries slowly in spring and after heavy rains. Surface drainage that speeds runoff is beneficial.

This soil is suited to all the crops commonly grown in the county. Where erosion is controlled and soil deterioration is prevented, continuous row crops can be grown safely. (Capability unit IIs–7; woodland group 12; recreation group 6; wildlife group 2)

Montello silt loam, 2 to 6 percent slopes (MsB).—This soil is adjacent to low areas. Its slopes are less than 300 feet long in most places. Soil areas are generally irregular in shape. This soil has slightly better drainage than Montello silt loam, 0 to 2 percent slopes, because runoff from the gentle slopes is faster.

Included with this soil in mapping are areas that are moderately eroded.

The main hazard to cultivation is erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded soil, and the organic-matter content and fertility are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIe–6; woodland group 12; recreation group 6; wildlife group 2)

Mosel Series

The Mosel series consists of deep, somewhat poorly drained, nearly level and gently sloping loamy soils. Ground water is 1 to 3 feet below the surface in most seasons. These soils are scattered through the county. They formed under mixed hardwoods in loamy deposits over calcareous lacustrine silt and clay.

In a representative profile the surface layer is about 8 inches of very dark brown loam. The subsurface layer is brown sandy loam about 7 inches thick. The lower part is about 14 inches thick and consists of dark-brown, mottled clay loam over reddish-brown and yellowish-red, mottled silty clay loam. The substratum is brown, mottled silty clay loam.

Mosel soils have high available water capacity, moderately slow permeability, and medium natural fertility.

Representative profile of Mosel loam, 0 to 3 percent slopes, in a cultivated field, SE¼SE¼ sec. 23, T. 17 N., R. 8 E., about 1,000 feet west of a bend in the County Road and about 100 feet north of the road.

Ap—0 to 8 inches, very dark brown (10YR 2/2) loam; moderate, medium and fine, granular structure; friable; medium acid; abrupt, smooth boundary.

A2—8 to 15 inches, brown (10YR 5/3) sandy loam; few, fine, prominent, strong-brown (7.5YR 5/6) mottles; few tongues of material that have a 10YR 3/2 or 3/1 hue penetrate this horizon; weak, medium, subangular blocky structure; friable; slightly acid; clear, smooth boundary.

B1—15 to 22 inches, dark-brown (7.5YR 4/4) sandy loam; many, fine and medium, prominent, yellowish-red (5YR 5/6) mottles and few, medium, distinct, brown (7.5YR 5/2) mottles; friable; slightly acid; clear, smooth boundary.

B21t—22 to 30 inches, dark-brown (7.5YR 4/4) and reddish-brown (5YR 5/3) sandy clay loam; common, medium, distinct, yellowish-red (5YR 5/6) mottles and few, medium, distinct, reddish-gray (5YR 5/2) mottles; weak, medium, subangular blocky structure; firm, slightly sticky; distinct clay bridging of sand grains; neutral; clear, smooth boundary.

IIB22t—30 to 36 inches, reddish-brown (5YR 4/4) and yellowish-red (5YR 5/6) heavy silty clay loam; many, fine, distinct, reddish-gray (5YR 5/2) mottles and common, fine, distinct, brown (7.5YR 5/2) mottles; moderate, medium, subangular blocky structure; firm, slightly sticky; thin, patchy clay films on ped faces; mildly alkaline; gradual, smooth boundary.

IIC—36 to 50 inches, brown (7.5YR 5/2) heavy silty clay loam that has thin layers of silt; few, medium, prominent, reddish-yellow (7.5YR 6/8) mottles; moderately alkaline.

Ap horizon of Mosel soils is loam or fine sandy loam. Depth to the underlying silt and clay ranges from 20 to 40 inches. In places streaks of very fine sand are in the lacustrine silt and clay at a depth of more than 30 inches. Depth to the moderately alkaline C horizon ranges from 24 to 42 inches.

In some places the Mosel soils in Marquette County have an A2 horizon that is somewhat finer textured than in the normal range for the series.

Mosel soils have less sand in the subsoil than the associated moderately well drained Seward soils and have a higher water table and mottling nearer the surface.

Mosel fine sandy loam, 0 to 3 percent slopes (MtA).—This soil is in low areas. In many places it is in transitional areas between well-drained and poorly drained soils.

The profile of this soil has a coarser textured surface layer than the profile described as representative for the series.

Included with this soil in mapping are areas that have a loamy sand surface layer.

Unless this soil is drained, it is generally too wet for cultivation. Adequately drained areas are used for most of the crops commonly grown in the county. Undrained areas are used for wildlife, trees, and pasture. (Capability unit IIw–2; woodland group 7; recreation group 4; wildlife group 5a)

Mosel loam, 0 to 3 percent slopes (MuA).—This soil is in low areas. In many places it is transitional between well-drained and poorly drained soils. The profile of this soil is representative for the series.

Unless drained, this soil is too wet for cultivation. Adequately drained areas are used for most crops commonly grown in the county. Undrained areas are used for trees, pasture, and wildlife. (Capability unit IIw–2; woodland group 7; recreation group 4; wildlife group 5a)

Moundville Series

The Moundville series consists of deep, moderately well drained, nearly level and gently sloping soils on outwash terraces. Ground water is less than 5 feet below the surface during short wet periods. These soils are scattered throughout the county. They formed under scattered mixed hardwods and native grasses in acid outwash sand.

In a representative profile the surface layer is very dark brown and very dark grayish brown loamy fine sand about 7 inches thick. The upper part of the subsoil is dark-brown loamy fine sand about 11 inches thick. The lower part is 14 inches thick and consists of dark-brown sandy loam over dark-brown loamy fine sand. The substratum is fine sand.

Moundville soils have low available water capacity, rapid permeability, and low natural fertility.

Representative profile of Moundville loamy fine sand, 0 to 3 percent slopes, in a cultivated field, SE¼SE¼ sec. 30, T. 14 N., R. 9 E., on abandoned farmland, 100 yards west of old U.S. Highway No. 51, at a point three-fifths mile south of its junction with U.S. Highway No. 51.

Ap—0 to 7 inches, very dark brown (10YR 2/2) and very dark grayish-brown (10YR 3/2) loamy fine sand; weak, fine, crumb structure; very friable; neutral; clear, smooth boundary.

B1—7 to 18 inches, dark-brown (7.5YR 4/4) loamy fine sand to fine sand; weak, fine, crumb structure to single grained; very friable to loose; strongly acid; clear, smooth boundary.

B2t—18 to 24 inches, dark-brown (7.5YR 4/4) light sandy loam to loamy fine sand; weak, fine and moderate, subangular blocky structure; very friable; clay bridging of sand grains; strongly acid; clear, smooth boundary.

B3—24 to 32 inches, dark-brown (7.5YR 4/4) loamy fine sand; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, moderate, subangular blocky structure to single grained; very friable to loose; strongly acid; gradual, smooth boundary.

C1—32 to 42 inches, brown (7.5YR 5/4) fine sand; many, fine, prominent, strong-brown (7.5YR 5/8) mottles; single grained; loose; strongly acid; gradual, smooth boundary.

C2—42 to 60 inches, yellowish-brown (10YR 5/4) fine sand; common, fine and medium, distinct, yellowish-brown (10YR 5/8) and strong-brown (7.5YR 5/8) mottles; single grained; loose; strongly acid.

The Ap horizon of Moundville soils is fine sandy loam or loamy fine sand. The B2 horizon ranges from loamy fine sand to fine sandy loam. The solum ranges from 24 to 36 inches in thickness and from medium acid to strongly acid. Thin bands of loamy sand to sandy loam are in the sand substratum.

Moundville soils have a higher water table than the associated well-drained Gotham soils. They also have distinct mottling below a depth of 24 inches, but in Gotham soils mottling does not occur above a depth of 60 inches.

Moundville loamy fine sand, 0 to 3 percent slopes (MvA).—Some areas of this soil are large and continuous, but others are small. The soil areas are generally irregular in shape. The profile of this soil is representative for the series.

This soil has low available water capacity and is susceptible to soil blowing. Unprotected areas that have been damaged by soil blowing have a thinner surface soil than uneroded soil and lower organic-matter content, fertility, and available water capacity.

This soil is suited to all the crops commonly grown in the county. (Capability unit IVs–3; woodland group 4; recreation group 5; wildlife group 3)

Moundville fine sandy loam, 0 to 3 percent slopes (MwA).—This soil is on terraces of outwash plains. Its areas are generally broad and continuous. The profile of this soil has a finer textured surface layer than the profile described as representative for the series.

Low available water capacity limits intensive cultivation on this soil, which is susceptible to soil blowing. Where soil has been lost by blowing, the surface soil is thinner than in the uneroded soil and the organic-matter content, fertility, and available water capacity are lower.

This soil is used for all the crops commonly grown in the county. (Capability unit IVs–3; woodland group 3; recreation group 5; wildlife group 3)

Mundelein Series

The Mundelein series consists of deep, somewhat poorly drained, nearly level and gently sloping, loamy soils in low areas. Ground water is 1 to 3 feet from the surface in wet seasons. These soils formed under scattered mixed hardwoods and native grasses in lacustrine silt and fine sand.

In a representative profile the surface layer is black and very dark grayish-brown silt loam about 12 inches thick. The upper part of the subsoil is dark-brown, mottled silty clay loam about 9 inches thick. The lower part is brown, mottled silt loam about 7 inches thick. The substratum is brown and pinkish-gray, stratified, mottled silt loam and very fine sand.

Mundelein soils have high available water capacity, moderately slow permeability, and medum natural fertility.

Representative profile of Mundelein silt loam, 0 to 3 percent slopes, in a cultivated field, NW¼SW¼ sec. 2, T. 16 N., R. 10 E.

Ap—0 to 9 inches, black (10YR 2/1) silt loam that has much sand; moderate, medium, granular structure; friable; numerous fine fibrous roots; moderately alkaline; abrupt, smooth boundary.

A3—9 to 12 inches, very dark grayish-brown (10YR 3/2) silt loam, few, fine, distinct, yellowish-brown (10YR 5/4) mottles; very weak, thick, platy structure parting to weak, medium, subangular blocky; friable; peds coated with dark gray (10YR 4/1); few fine fibrous roots; mildly alkaline; clear, wavy boundary.

B2t—12 to 21 inches, dark-brown (7.5YR 4/4) silty clay loam; common, fine, distinct, strong-brown (7.5YR 5/6) and grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm; neutral; clear, wavy boundary.

B3—21 to 28 inches, brown (7.5YR 5/4) silt loam; common, fine, distinct, strong-brown (7.5YR 5/6) and prominent grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm; neutral; clear, wavy boundary.

C1g—28 to 30 inches, brown (7.5YR 5/2) silt loam, common, medium, prominent, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable; moderately calcareous; gradual, wavy boundary.

C2g—30 to 60 inches, pinkish-gray (7.5YR 6/2) stratified silt loam and very fine sand; common, medium, prominent, strong-brown (7.5YR 5/8) mottles; massive to very weak, platy structure; friable; few thin lenses of silty clay loam; moderately alkaline.

The Ap horizon is generally very dark brown, black, or very dark grayish brown. The A3 horizon generally is thin and in places has subangular blocky structure. The B2 horizon has medium or moderately fine texture. Depth to mottling ranges from 6 to 18 inches. Depth to the C horizon ranges from about 20 to 40 inches. The C horizon is dominantly stratified silt and fine or very fine sand, but in many places it has thin lenses that are loam or finer textured. The solum ranges from slightly acid to alkaline. Carbonates generally are within a depth of 3 feet.

In Marquette County, Mundelein soils are outside the defined range for the series because they have a redder hue, but this does not alter their usefulness or behavior.

These soils have a finer textured subsoil than the associated Yahara soils.

Mundelein loam, 0 to 3 percent slopes (MxA).—This soil is in low areas. Its areas range from broad and continuous to long and narrow or irregular in shape. The profile of this soil has a coarser textured surface layer than the profile described as representative for the series.

Wetness is the major limitation to cultivation of this soil. If drainage is adequate, this soil is suited to most of the crops commonly grown in the county. Undrained areas are suited to trees, pasture, and plants for wildlife food and cover. (Capability unit IIw–2; woodland group 7; recreation group 4; wildlife group 5a)

Mundelein silt loam, 0 to 3 percent slopes (MyA).—This soil is in low areas. Its areas range from broad and continuous to long and narrow or irregular in shape. The profile of this soil is representative of the series. If drainage is adequate, this soil is suited to most crops commonly grown in the county. Undrained areas are used for pasture, trees, and plants for wildlife food and cover. (Capability unit IIw–2; woodland group 7; recreation group 4; wildlife group 5a)

Oshtemo Series

The Oshtemo series consists of deep, well-drained, nearly level to moderately steep sandy to loamy soils on outwash benches. Ground water is more than 5 feet from the surface throughout the year. These soils formed under mixed hardwoods in calcareous outwash sand and gravel.

In a representative profile the surface layer is brown loamy fine sand about 4 inches thick. The subsurface layer is 7 inches of yellowish-brown loamy fine sand. The upper part of the subsoil is 5 inches of strong-brown sandy loam. The middle is 18 inches of dark-brown sandy loam. The lower part is dark-brown loamy sand about 8 inches thick. The substratum is pale-brown sand.

Oshtemo soils have low available water capacity, moderately rapid permeability, and low natural fertility.

Representative profile of Oshtemo loamy fine sand, 0 to 2 percent slopes, SW¼SE¼ sec. 8, T. 16 N., R. 10 E.

Ap—0 to 4 inches, very dark grayish-brown (10YR 3/2) loamy fine sand; very weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

A2—4 to 11 inches, yellowish-brown (10YR 5/4) loamy fine sand; single grained; friable; strongly acid; clear, wavy boundary.

B1—11 to 16 inches, strong-brown (7.5YR 5/6) light sandy loam; weak, medium, subangular blocky structure; some clay bridging of sand grains; medium acid; clear, wavy boundary.

B2t—16 to 34 inches, dark-brown (7.5YR 4/4) sandy loam; weak, medium, subangular blocky structure; clay bridging between sand grains; friable to firm; medium acid; clear, wavy boundary.

B3t—34 to 42 inches, dark-brown (7.5YR 4/4) loamy sand; weak, medium, subangular blocky structure; clay bridging between sand grains; firm; medium acid; gradual, wavy boundary.

C—42 to 60 inches, pale-brown (10YR 6/3 loose, moderately alkaline sand and a few fine pebbles; single grained.

The Oshtemo soils have a loamy fine sand or fine sandy loam surface layer. In uncultivated areas the surface layer is black and is about 3 to 4 inches thick. Depth to the underlying moderately alkaline substratum (outwash) ranges from 36 to more than 48 inches, but in some areas the substratum is medium acid to mildly alkaline sand. The B2 horizon ranges from light sandy loam to sandy clay loam. The sandy clay loam horizon is less than 10 inches thick and, in some areas, is absent. Gravel content ranges from little to none.

The Oshtemo soils have a sandy clay loam to loam B2 horizon less than 10 inches thick in some areas, and the associated somewhat darker colored Gotham soils do not. Oshtemo soils formed in calcareous outwash materials, whereas Gotham soils formed in noncalcareous sands.

Oshtemo loamy fine sand, 0 to 2 percent slopes (OsA).—This soil is on outwash terraces. Many soil areas are large and continuous, but others are relatively small. Soil areas are normally irregular in shape. The profile of this soil is representative for the series.

This soil has low available water capacity and is susceptible to soil blowing. Unprotected areas that have been damaged by erosion have a thinner surface soil than the uneroded areas and lower organic-matter content, fertility, and available water capacity.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIs–4; woodland group 4; recreation group 5; wildlife group 3)

Oshtemo loamy fine sand, 2 to 6 percent slopes (OsB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are irregular in shape. The profile of this soil has a slightly thinner subsoil than the profile described as representative for the series. Overwash soils are in some areas of small depressions.

Included with this soil in mapping are moderately eroded areas.

This soil has low available water capacity and is susceptible to soil blowing and water erosion. Areas damaged by erosion have a thinner surface soil than uneroded areas and lower organic-matter content, fertility, and available water capacity.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIs–4; woodland group 4; recreation 5; wildlife group 3)

Oshtemo loamy fine sand, 6 to 12 percent slopes, eroded (OsC2).—The slopes of this soil are less than 200 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a thinner subsoil and a thinner, lighter colored surface layer than the profile described as representative for the series.

Included with this soil in mapping are areas in woods and permanent pasture that are only slightly eroded. Also included are areas that have complex rolling slopes.

This soil is susceptible to soil blowing and moderate water erosion. In unprotected areas that have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIe–7; woodland group 4; recreation group 5; wildlife group 3)

Oshtemo loamy fine sand, 12 to 20 percent slopes, eroded (OsD2).—The slopes of this soil are less than 400 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a thinner, lighter colored surface layer and a thinner subsoil than the profile described as representative for the series.

Included with this soil in mapping are small areas that have a fine sand surface layer. Also included are areas in woods and permanent pasture that are slightly eroded. Other inclusions are very stony.

Erosion has decreased the thickness of the surface soil and has lowered the organic-matter content, fertility, and available water capacity. Gullies have formed in places.

This soil is suited to all crops commonly grown in the county, but it is better suited to hay and pasture than to other crops. Woodland and wildlife are also suitable uses. (Capability unit IVe–7; woodland group 4; recreation group 5; wildlife group 3)

Oshtemo fine sandy loam, 0 to 2 percent slopes (OtA).—This soil is on outwash terraces. Many soil areas are large and continuous, but others are relatively small. Soil areas are normally irregular in shape. The profile of this soil has a finer textured surface layer than the profile described as representative for the series.

This soil has low available water capacity and is susceptible to soil blowing. Where soil has been lost, the surface soil is thinner than in the profile described as representative for the series and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIs–4; woodland group 3; recreation group 5; wildlife group 1)

Oshtemo fine sandy loam, 2 to 6 percent slopes (OtB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are irregular in shape. The profile of this soil has a slightly thinner subsoil and a finer textured surface layer than the profile described as representative for the series.

Included with this soil in mapping are areas of stony soil. Also included are moderately eroded areas.

This soil has low available water capacity and is susceptible to soil blowing and water erosion. Where soil has been lost by erosion, the surface soil is thinner than in uneroded soil and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIs–4; woodland group 3; recreation group 5; wildlife group 1)

Oshtemo fine sandy loam, 6 to 12 percent slopes, eroded (OtC2).—The slopes of this soil are less than 300 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a thinner subsoil and a thinner, lighter colored, finer textured surface layer than the profile described as representative for the series.

Included with this soil in mapping are small areas that have complex, rolling slopes.

This soil is susceptible to soil blowing and moderate water erosion. Some unprotected areas have been damaged by erosion. In these areas the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIe–7; woodland group 3; recreation group 5; wildlife group 1)

Palms Series

The Palms series consists of moderately deep, very poorly drained organic soils on the lowlands. Ground water is at or near the surface throughout the year. These soils occur irregularly throughout the county. They formed under sedges and marsh grasses in decaying organic remains over loamy soil.

In a representative profile the organic part of this soil is about 36 inches of black mucky peat that has granular structure. It has a few, fine plant fibers that are less decomposed than the main body of the organic soil. The substratum is grayish-brown, massive light silty clay loam. It is mildly alkaline.

Palms soils have high available water capacity and low natural fertility. The permeability of the organic part of this soil is moderately rapid and of the substratum is moderately slow.

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Representative profile of Palms mucky peat, deep, in a cultivated field that has been plowed to a depth of 24 inches, NE¼NE¼ sec. 33, T. 15 N., R. 10 E.

Oa1—0 to 12 inches, black (10YR 2/1) sapric material; few, fine, distinct, yellowish-brown (10YR 5/4) plant fragments; fine, granular structure; friable; medium acid; clear, smooth boundary.

Oa2—12 to 24 inches, black (10YR 2/1) sapric material; few, fine, faint, dark-brown (10YR 4/3) plant fibers; friable; medium acid; clear to abrupt, smooth boundary caused by deep plowing operations.

Oa3—24 to 36 inches, black (N 2/0) sapric material; fine granular structure; few mineral grains present; friable; slightly acid; abrupt, smooth boundary.

IICg—36 to 60 inches, grayish-brown (2.5Y 5/2) light silty clay loam; stratified; massive; firm; mildly alkaline.

The Oa1 horizon of Palms soils is mucky peat or muck in most areas. In some places coarse-textured bands occur in the mineral substratum.

Palms soils are underlain by loamy soil at a depth of 10 to 48 inches, but Houghton soils formed in organic materials that extend to a depth of more than 48 inches, and Adrian and Rollin soils are underlain by sand and marl, respectively. All these soils formed in organic deposits.

Palms mucky peat, deep (0 to 2 percent slopes) (Pa).—This soil is in broad to long and narrow or irregularly shaped low areas. The profile of this soil is representative for the series.

This soil is susceptible to soil blowing and subsidence where drained. Drained areas are used for corn and truck crops. Controlling the water table helps to reduce oxidation and subsidence. Undrained areas are used for pasture, woodland, and wildlife. (Capability unit IIw–8; woodland group 10; recreation group 1; wildlife group 6)

Palms mucky peat, shallow (0 to 2 percent slopes) (Pc).—This soil is in low areas. It is shallower (10 to 30 inches) to the substratum than the representative soil.

Palms mucky peat, shallow, is susceptible to blowing and subsidence where drained. Drained areas are used for corn and truck crops. Controlling the water table helps to reduce oxidation and subsidence. (Capability unit IIw–8; woodland group 10; recreation group 1; wildlife group 6)

Pardeeville Series

The Pardeeville series consists of deep, well-drained, gently sloping to steep soils that are underlain by loamy sand or sandy loam till. These soils formed under native grasses and widely spaced mixed hardwoods.

In a representative profile the surface layer is very dark brown fine sandy loam about 8 inches thick. The subsurface layer is about 1 inch of brown, friable loamy fine sand. The subsoil is dark-brown and reddish-brown sandy loam in the upper 6 inches and 10 inches of reddish-brown, heavy sandy loam containing a few stones and pebbles in the middle. The lower part is 9 inches of reddish-brown and yellowish-red light sandy loam and a few stones and pebbles. The substratum is dark-brown and strong-brown light loamy sand.

Pardeeville soils have medium available water capacity, moderately rapid permeability, and medium natural fertility.

Representative profile of the Pardeeville part of Lapeer-Pardeeville fine sandy loams, 2 to 6 percent slopes, in an uncultivated area, NW¼SE¼ sec. 14, T. 14 N., R. 10 E.; 500 feet north of a bend in the County Road 50 feet west of the road.

A1—0 to 8 inches, very dark brown (10YR 2/2) and very dark grayish-brown (10YR 3/2) fine sandy loam; weak, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

A2—8 to 9 inches, brown (7.5YR 5/2) loamy fine sand and a few tongues of dark brown (7.5YR 3/2) from horizon above; weak, medium, subangular blocky structure; friable; medium acid; clear, smooth boundary.

B1—9 to 15 inches, dark-brown (7.5YR 4/4) and reddish-brown (5YR 4/4) light sandy loam; weak to moderate, medium, subangular blocky structure; friable; strongly acid; clear, smooth boundary.

B2t—15 to 25 inches, reddish-brown (5YR 4/4) heavy sandy loam; moderate, medium, subangular blocky structure; firm; thin, patchy clay films on ped faces; strongly acid; clear, smooth boundary.

B3t—25 to 34 inches, reddish-brown (5YR 4/4) and yellowish-red (5YR 4/6) light sandy loam; moderate, medium, subangular blocky structure; friable, slightly hard, slightly plastic; few clay films on ped faces; clay bridging between sand grains is distinctive near lower boundary; dark-brown (7.5YR 3/2) organic coatings on peds at lower boundary; medium acid; clear, wavy boundary.

C—34 to 68 inches, dark-brown (7.5YR 4/4) and strong-brown (7.5YR 5/6) loamy sand; massive or weak, coarse, platy structure; friable; slightly acid, neutral below depth of 40 inches.

The A1 horizon ranges from black to dark brown. It has weak, medium, granular structure in places. In uncultivated areas A1 horizon ranges from 5 to 8 inches in thickness, and in cultivated areas this layer is 7 to 9 inches thick. The solum ranges from 24 to 36 inches in thickness. In some areas these soils are underlain by sandstone bedrock at a depth of more than 36 inches.

Pardeeville soils have a thicker, darker colored surface horizon than Wyocena soils and are generally somewhat finer textured throughout the solum. They have a finer textured, thinner solum (less than 40 inches thick) than the Mecan soils. Pardeeville soils are darker colored than the Lapeer soils. All of these associated soils are underlain by sandy or sandy loam glacial till.

In Marquette County Pardeeville soils are mapped only in a complex with Lapeer soils.

Plainfield Series

The Plainfield series consists of deep, excessively drained, nearly level to moderately steep soils on outwash benches. These soils occur at random throughout the county. They formed under predominantly black oaks in acid outwash sand.

In a representative profile the surface layer is a dark grayish-brown loamy fine sand about 8 inches thick. The upper part of the substratum is 20 inches of medium acid, brown loose sand. The lower part, to a depth of 60 inches, is yellowish-brown, strongly acid sand.

Plainfield soils have very low available water capacity, very rapid permeability, and very low natural fertility. They have a low shrink-swell potential, good shear strength, and very low compressibility.

The nearly level and gently sloping areas of the Plainfield soils have good potential for irrigation. Many areas are planted to trees (fig. 8).

Representative profile of Plainfield loamy fine sand, 2 to 6 percent slopes, in a cultivated field, SW¼SE¼ sec. 7, T. 16 N., R. 8 E.

Figure 8.—**Landscape of Plainfield soils that were formerly cultivated but are now planted to red pine.**

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loamy fine sand; weak, very fine, granular structure; very friable; neutral; abrupt, smooth boundary.
C1—8 to 28 inches, brown (7.5YR 5/4) sand; single grained; loose; medium acid; gradual, wavy boundary.
C2—28 to 60 inches, yellowish-brown (10YR 5/6) sand; single grained; loose; strongly acid.

The Ap horizon of Plainfield soils is loamy fine sand or fine sand. The upper part of the C horizon, within 20 inches of the surface, ranges from loamy fine sand to fine sand.

Plainfield soils are coarser textured and lighter colored than the associated Gotham soils.

Plainfield sand, 0 to 12 percent slopes, eroded (PfC2).—The slopes of this soil are less than 300 feet long in most places. Soil areas vary in size and shape.

The profile of this soil has a coarser textured, lighter colored surface soil than the profile described as representative for the series. Many areas have lost most or all of the dark-brown surface layer by soil blowing.

This soil has very low available water capacity and is very susceptible to soil blowing.

This soil is more suitable as woodland and for wildlife than for other uses. (Capability unit VIs–3; woodland group 4; recreation group 5; wildlife group 3)

Plainfield sand, 12 to 20 percent slopes, eroded (PfD2).—The slopes of this soil are less than 200 feet long in most places. Soil areas are generally irregular in shape.

The profile of this soil has a coarser textured, lighter colored surface layer than the profile described as representative for the series. Most areas have lost much or all of the dark-brown surface layer by soil blowing and water erosion.

Included with this soil in mapping are small areas of steep soils.

This soil is too droughty and steep for cultivation. Because slopes are moderately steep, using mechanical tree planting equipment is difficult. The soil is very susceptible to soil blowing and water erosion.

This soil is better suited to recreation, wildlife, and trees than to other uses. (Capability unit VIIs–3; woodland group 4; recreation group 5; wildlife group 3)

Plainfield loamy fine sand, 0 to 2 percent slopes (PlA).—This soil is on terraces. Some soil areas are large and continuous, but others are relatively small. Most areas are irregular in shape.

The profile of this soil has a slightly darker colored surface layer containing more organic matter than has the profile described as representative for the series. In some places the loamy fine sand extends to a depth of 18 to 20 inches.

Included with this soil in mapping are small areas that are moderately eroded by soil blowing.

This soil has very low available water capacity. It is susceptible to blowing.

This soil is suited to all crops commonly grown in the county. Irrigation systems work well on these nearly

level, sandy soils. (Capability unit IVs–3; woodland group 4; recreation group 5; wildlife group 3)

Plainfield loamy fine sand, 2 to 6 percent slopes (PlB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are quite irregular in shape. The profile of this soil is representative for the series.

Included with this soil in mapping are areas that are moderately eroded.

This soil has very low available water capacity and is susceptible to soil blowing and water erosion. In eroded areas the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IVs–3; woodland group 4; recreation group 5; wildlife group 3)

Plainfield loamy fine sand, 6 to 12 percent slopes (PlC).—The slopes of this soil are less than 300 feet long in most places. Soil areas are generally irregular in shape.

The profile of this soil has a somewhat thinner, lighter colored surface layer than the profile described as representative for the series.

Included with this soil in mapping are some areas that are moderately eroded.

This soil has very low available water capacity. It is susceptible to soil blowing and moderate water erosion. In eroded areas the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to pasture that has limited grazing. Woodland and wildlife are also suitable uses. This soil is more difficult to irrigate than nearly level or gently sloping soils. (Capability unit VIs–3; woodland group 4; recreation group 5; wildlife group 3)

Plainfield loamy fine sand, 12 to 20 percent slopes, eroded (PlD2).—The slopes of this soil are less than 200 feet long in most places. Soil areas are generally irregular in shape.

The profile of this soil has a thinner, lighter colored surface layer than the profile described as representative for the series and a somewhat lighter colored layer just beneath the surface layer.

Included with this soil in mapping are wooded areas and grazed permanent pasture that are slightly eroded.

This soil is too steep for cultivation. The slopes make tree planting more difficult than on gentler slopes. The soil is very susceptible to water erosion. In eroded areas the surface soil is thinner than in uneroded areas and the organic-matter content, fertility. and available water capacity are lower. This soil is better suited to trees, wildlife, and recreation areas than to other uses. (Capability unit VIIs–3; woodland group 4; recreation group 5; wildlife group 3)

Plainfield-Wyocena complex, 2 to 6 percent slopes (PnB).—This complex is about 60 percent Plainfield loamy fine sand and 40 percent Wyocena loamy fine sand. Slopes are less than 300 feet long in most places. Soil areas are generally irregular in shape. These soils are underlain by sandstone bedrock at a depth of more than 30 inches.

Included with these soils in mapping are areas that are moderately to severely eroded and some nearly level areas. Sandstone crops out (fig. 9) in some places.

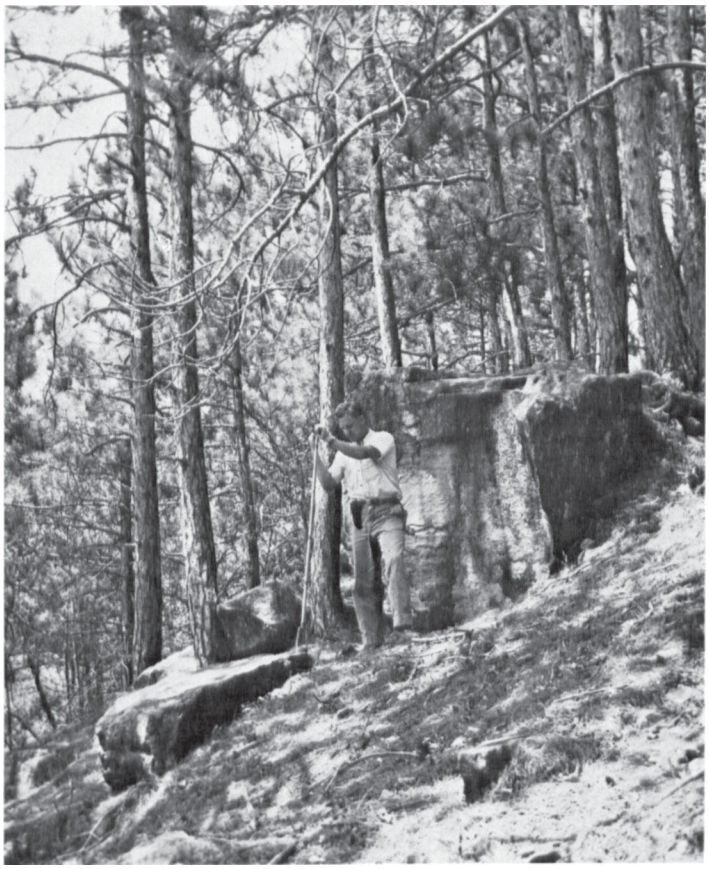

Figure 9.—**Sandstone outcrop in an area of Plainfield-Wyocena complex.**

These soils have low available water capacity and are susceptible to soil blowing and water erosion. Unprotected areas have been damaged by erosion. In eroded areas the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

These soils are suited to all crops commonly grown in the county. (Capability unit IVs–3; woodland group 4; recreation group 5; wildlife group 3)

Plainfield-Wyocena complex, 6 to 12 percent slopes (PnC).—This complex is about 55 percent Plainfield loamy fine sand and 45 percent Wyocena loamy fine sand. Slopes are less than 300 feet long in most places. Soil areas are generally irregular in shape. These soils are underlain by sandstone bedrock at a depth of more than 30 inches.

Included with these soils in mapping are areas that are moderately eroded.

These soils are too steep and sandy for cultivation. They are susceptible to soil blowing and water erosion. In eroded areas the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

These soils are suited to pasture, trees, or wildlife. (Capability unit VIs–3; woodland group 4; recreation group 5; wildlife group 3)

Plainfield-Wyocena complex, 12 to 30 percent slopes (PnE).—This complex is about 50 percent Plainfield soils

and 50 percent Wyocena soils. These are sandy soils. Slopes are less than 200 feet long in most places. Soil areas are generally elongated to irregular in shape. The profiles of these soils have a thinner solum than the profiles described as representative for the series and are underlain by sandstone at a depth of more than 30 inches.

Included with these soils in mapping are moderately eroded areas.

These soils are too steep for cultivation. They are susceptible to severe water erosion. In eroded areas, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

These soils are suited to pasture that has limited grazing. Woodland and wildlife are also suitable uses. (Capability unit VIIs–3; woodland group 4; recreation group 5; wildlife group 3)

Poygan Series

The Poygan series consists of deep, poorly drained, nearly level, fine-textured soils on lake-laid benches. Ground water is at or near the surface for considerable periods during the year. These soils formed under lowland hardwoods and grasses in calcareous glaciolacustrine silt and clay.

In a representative profile the surface layer is black silty clay loam about 8 inches thick. The subsoil is about 18 inches thick and consists of very dark gray, gray, and light olive-gray silty clay. The substratum is light-brown, moderately alkaline clay.

Poygan soils have high available water capacity, slow permeability, and medium natural fertility.

Representative profile of Poygan silty clay loam, in a cultivated field, NE¼NE¼ sec. 19, T. 14 N., R. 8 E.

Ap—0 to 8 inches, black (N 2/0) silty clay loam; strong, medium, granular structure; friable; mildly alkaline; abrupt, smooth boundary.

B1g—8 to 11 inches, very dark gray (N 3/0) silty clay; moderate, medium, subangular blocky structure; firm; mildly alkaline; clear, smooth boundary.

B21gt—11 to 18 inches, gray (5Y 4/1) silty clay; strong, medium, subangular blocky structure; continuous clay films on all ped faces; very firm; mildly alkaline; clear, smooth boundary.

B22gt—18 to 26 inches, light olive-gray (5Y 6/2) silty clay; common, medium, distinct, light-brown (7.5YR 6/4) mottles in lower 2 inches; strong to moderate, medium, subangular blocky structure; clay films on all ped faces; very firm; moderately calcareous; clear, smooth boundary.

C1g—26 to 32 inches, light-brown (7.5YR 6/4) clay; common, medium, prominent, reddish-yellow (7.5YR 6/8) mottles; weak, coarse, subangular blocky structure; moderately alkaline; gradual, smooth boundary.

C2g—32 to 60 inches, light-brown (7.5YR 6/4) clay; traces of gleying to depth of 60 inches; massive; firm; moderately alkaline.

The Poygan soils have a fine sandy loam or silty clay loam A horizon. Depth to the moderately alkaline C horizon ranges from 20 to 30 inches. The substratum ranges from silty clay to clay.

The Poygan soils formed in silt and clay, but the Colwood soils formed in silt and fine sand. Both kinds of soil formed in lacustrine deposit.

Poygan fine sandy loam (0 to 2 percent slopes) (Po).—The areas of this soil range from broad and irregular to long and narrow in shape. The profile of this soil has a coarser textured surface layer than the profile described as representative for the series. Some areas have sandy layers in the substratum. Unless it is drained, this soil is too wet for cultivation. Drained areas are used for most crops commonly grown in the county. Alfalfa is susceptible to winterkill in this wet soil. Under a high level of management, corn can be safely grown continuously. Undrained areas are used for woodland, pasture, and wildlife. (Capability unit IIw–1; woodland group 7; recreation group 3; wildlife group 5b)

Poygan silty clay loam (0 to 2 percent slopes) (Ps).—Areas of this soil range from broad and irregular to long and narrow in shape. The profile of this soil is the one described as representative for the series.

Included with this soil in mapping are gently sloping areas.

Unless it is drained, this soil is too wet for cultivation. Drained areas are suited to most crops commonly grown in the county. Alfalfa is susceptible to winterkill on these wet soils. Under good management corn can be safely grown continuously. Undrained areas are used for woodland, pasture, and wildlife. (Capability unit IIw–1; woodland group 7; recreation group 3; wildlife group 5b)

Rollin Series

The Rollin series consists of deep, very poorly drained, organic soils in lowlands. These soils formed under sedges and marsh grasses in decaying organic remains over marl.

In a representative profile the organic part of the soil is about 36 inches of very dark brown and black mucky peat and few hairlike plant fibers. The substratum is light brownish-gray marl and many fine to medium snail shells.

Rollin soils have very high available water capacity and low natural fertility. Permeability of the organic part is moderately rapid, and permeability of the substratum is slow.

Representative profile of Rollin mucky peat, in an uncultivated area, NE¼SW¼ sec. 17 T. 17 N., R. 8 E.

Oa1—0 to 10 inches, very dark brown (10YR 2/2) sapric material; few, fine, distinct, yellowish-brown (10YR 5/6) plant fibers; weak, medium, granular structure; very friable; calcareous; mildly alkaline; gradual, smooth boundary.

Oa2—10 to 20 inches, very dark brown (10YR 2/2) sapric material; few, very fine, hairlike, brown (10YR 5/3) fibers; massive; friable; calcareous; mildly alkaline; gradual, smooth boundary.

Oa3—20 to 28 inches, black (N 2/0) sapric material; few, fine, distinct, yellowish-brown (10YR 5/6) plant fibers; massive; friable; calcareous; mildly alkaline; gradual, smooth boundary.

Oa4—28 to 36 inches, very dark brown (10YR 2/2) sapric material; few, fine, hairlike, faint, dark-brown to brown (10YR 4/3) plant fibers; weak, medium, platy structure; friable; calcareous; mildly alkaline; clear, smooth boundary.

IIC—36 to 60 inches, light brownish-gray (2.5Y 6/2) marl; many, fine to medium, prominent, white (2.5Y 8/2) snail shells; massive; friable; calcareous; moderately alkaline; snail shells decrease as depth increases.

The Oa1 horizon is very dark brown or black. In some places marl deposits are underlain by other mineral deposits at a

depth of more than 4 feet. The depth to the underlying marl ranges from 10 to 48 inches.

Rollin soils have different texture of the underlying mineral deposits than the associated Palms and Adrian organic soils and have a more alkaline upper part of the profile.

Rollin mucky peat (0 to 2 percent slopes) (Ro).—This soil is in broad to long and narrow or irregularly shaped areas of the lowlands.

Shallow depth to marl and wetness are the main hazards to cultivation of this soil. Most areas are used for pasture, woodland, or wildlife. In some places these soils are mined for lime that is used to reduce acidity in cultivated soils. (Capability unit IVw–7; woodland group 10; recreation group 1; wildlife group 6)

Seward Series

The Seward series consists of deep, moderately well drained, nearly level and gently sloping soils. Ground water is less than 5 feet from the surface during wet periods. These soils formed under mixed hardwoods in sandy material over lacustrine silt and clay.

In a representative profile the surface layer is black fine sandy loam about 3 inches thick. The subsurface layer is about 7 inches of yellowish-brown loamy fine sand. The upper part of the subsoil is dark yellowish-brown loamy fine sand about 10 inches thick. The lower part is reddish-brown, mottled clay loam and silty clay about 16 inches thick. The substratum is moderately alkaline reddish-brown silty clay loam.

Seward soils have medium available water capacity, slow permeability, and low natural fertility.

Representative profile of Seward fine sandy loam, 0 to 2 percent slopes, in an uncultivated area, NE¼SW¼ sec. 13, T. 16 N., R. 8 E. A few stones and boulders are on the soil surface.

A1—0 to 3 inches, black (10YR 2/1) fine sandy loam; moderate, medium, granular structure; very friable; strongly acid; clear boundary.

A2—3 to 10 inches, yellowish-brown (10YR 5/4) loamy fine sand; weak, thick, platy structure that parts to weak, medium, subangular blocky; very friable; slightly acid; loose when crushed; few stones; clear boundary.

B1—10 to 20 inches, dark yellowish-brown (10YR 4/4) loamy fine sand; weak, medium to coarse, subangular blocky structure; few clay bridges between sand grains; very friable; slightly acid; few stones; clear boundary.

IIB21t—20 to 23 inches, reddish-brown (5YR 4/4) clay loam; few, fine, prominent, dark-gray (10YR 4/1) mottles; moderate, medium, subangular blocky structure; clay films on ped faces; firm; mildly alkaline; clear boundary.

IIB22t—23 to 36 inches, reddish-brown (5YR 4/4) silty clay; few, fine, prominent, dark-gray (10YR 4/1) mottles; moderate, medium, subangular blocky structure; clay films on ped faces; firm, slightly plastic, wet; mildly alkaline; clear boundary.

IIC—36 to 60 inches, reddish-brown (5YR 5/4) silty clay loam; weak, coarse, subangular blocky structure; slightly sticky; moderately alkaline.

The Ap horizon in cultivated areas is generally dark grayish-brown and is about 8 inches thick. In some places streaks of fine sand are in the substratum with the lacustrine silt and clay. Depth to the underlying silt and clay ranges from 20 to 40 inches. Depth to the moderately alkaline C horizon ranges from 24 to 48 inches.

Seward soils are sandy to a depth of more than 18 inches, but the Montello soils are not.

Seward soils have lacustrine silt and clay rather than silt and fine sand in the substratum as do the Metea stratified substratum soils. All of these soils are formed in lacustrine deposits.

Seward fine sandy loam, 0 to 2 percent slopes (SeA).—This soil is generally adjacent to low areas. Soil areas range from broad and continuous or irregular to long and narrow in shape. The profile of this soil is representative for the series.

Included with this soil in mapping are areas of a soil that has a loamy sand surface layer.

This Seward soil is slightly susceptible to soil blowing. In eroded areas the surface soil is thinner than in uneroded areas, and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. Minimum tillage and conservation of residues help to maintain good tilth, organic-matter content, and fertility. (Capability unit IIIs–2; woodland group 1; recreation group 5; wildlife group 1)

Seward fine sandy loam, 2 to 6 percent slopes (SeB).—The slopes of this soil are less than 200 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a slightly thinner sandy subsurface layer (about 15 inches thick) than the profile described as representative for the series.

Included with this soil in mapping are small areas of soils that have a loam and loamy sand surface layer.

This soil is susceptible to soil blowing and water erosion. In eroded areas the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all crops commonly grown in the county. (Capability unit IIIe–4; woodland group 1; recreation group 5; wildlife group 1)

Sisson Series

The Sisson series consists of deep, well-drained, nearly level and gently sloping, loamy soils. Ground water is more than 5 feet from the surface throughout the year. These soils formed under mixed hardwoods in calcareous glaciolacustrine silt and fine sand.

In a representative profile the surface layer is dark-brown fine sandy loam about 4 inches thick. The subsurface layer is about 4 inches of dark yellowish-brown fine sandy loam. The subsoil is reddish-brown loam and silty clay loam in the upper 10 inches and 12 inches of dark-brown loam in the lower part. The substratum is dark-brown stratified, calcareous silt loam, silt, and fine sand.

Sisson soils have high available water capacity, moderate permeability, and medium natural fertility.

Representative profile of Sisson fine sandy loam, 0 to 2 percent slopes, in an uncultivated area, SW¼NW¼ sec. 19, R. 15 N., R. 8 E.

A1—0 to 4 inches, dark-brown (7.5YR 3/2) fine sandy loam; moderate, fine, granular structure; very friable; neutral; clear, smooth boundary.

A2—4 to 8 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; moderate, thin, platy structure; very friable; intense earthworm activity; neutral; clear, smooth boundary.

B1—8 to 10 inches, reddish-brown (5YR 4/4) loam; weak, medium, platy and moderate, fine, blocky structure; friable; neutral; gradual, wavy boundary.

B21t—10 to 18 inches, reddish-brown (5YR 4/4) silty clay loam; continuous clay films on ped faces; moderate, fine, blocky structure; friable; neutral; gradual, wavy boundary.

B22t—18 to 30 inches, dark-brown (7.5YR 4/4) loam; dark organic stains on peds; moderate, fine, blocky structure; patchy clay films on ped faces; friable; neutral; gradual, wavy boundary.

C—30 to 60 inches, dark-brown (7.5YR 4/4) stratified silt loam, silt, and fine sand; moderate, medium, blocky structure; firm; moderately alkaline.

The A1 horizon of Sisson soils is loam or fine sandy loam. In cultivated areas the Ap horizon ranges from 6 to 8 inches in thickness and is generally dark grayish-brown. Depth to the calcareous C horizon ranges from 24 to 40 inches. In some nearly level areas, the Sisson soils are moderately well drained. The lacustrine deposit underlying these soils ranges from mainly silt to nearly equal parts of silt and fine sand. In some places there are thin layers of clay. The B2 horizon ranges from loam to silty clay loam.

The Sisson soils formed in silt and fine sand, not in silt and silty clay loam as did the Briggsville soils. Sisson soils are lighter colored than the Mundelein soils and lack mottling in the profile. Also, the water table is deeper in Sisson soils than in Mundelein soils. All of these soils formed in lacustrine deposits.

Sisson fine sandy loam, 0 to 2 percent slopes (SoA).—This soil is on lake-laid benches. Its profile is representative for the series. Included with this soil in mapping are soils that have mottling in the lower part of the subsoil.

The main hazard to cultivation of this soil is soil blowing. Cultivation can be fairly intensive where stripcropping and cover crops are used to help control soil blowing. This soil is used for the crops commonly grown in the county. (Capability unit I–4; woodland group 1; recreation group 5; wildlife group 1)

Sisson fine sandy loam, 2 to 6 percent slopes, eroded (SoB2).—The slopes of this soil are less than 500 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a thinner surface layer than the profile described as representative for the series.

Included with this soil in mapping are small areas of a soil that has a silt loam surface layer. Also included are small areas that are gently undulating. Other inclusions are wooded areas and parts of permanent pastures that are slightly eroded.

This soil is susceptible to soil blowing and water erosion. In eroded areas the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIe–2; woodland group 1; recreation group 5; wildlife group 1)

Sisson loam, 0 to 2 percent slopes (SsA).—This soil is on lake-laid terraces. Its profile has a finer textured loam surface layer than the profile described as representative for the series. Some areas of this soil are wet for long periods early in the spring and after heavy rains.

Included with this soil in mapping are moderately well drained areas that are mottled in the lower part of the subsoil. Also included are small areas of a soil that has a silt loam surface layer. Under good management corn can be safely grown continuously. (Capability unit I–4; woodland group 1; recreation group 5; wildlife group 1)

Sisson loam, 2 to 6 percent slopes (SsB).—This soil is on lake-laid terraces. Slopes are less than 300 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a thinner combined surface layer and subsoil (about 30 inches thick) than the profile described as representative for the series. The soil in some small areas has a very dark colored surface layer.

This soil is susceptible to water erosion. In eroded areas, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIe–2; woodland group 1; recreation group 5; wildlife group 1)

Steep Sandy Land

Steep sandy land is a miscellaneous land type that consists of relatively unweathered sand. These areas are generally sides of kettle holes or steep-sided drainageways. Steep sandy land is very susceptible to water erosion.

Steep sandy land (20 to 40 percent slopes) (StF).—This land type consists of steep and very steep, sandy areas.

These areas are too steep for cultivation. The very steep slopes make it difficult to use mechanical tree planting equipment. Some areas are moderately eroded.

This land is suited to woods, wildlife habitat, and recreation areas. (Capability unit VIIs–9; woodland group 4; recreation group 5; wildlife group 3)

Tedrow Series

The Tedrow series consists of deep, somewhat poorly drained, sandy soils on level to gently sloping glacial outwash plains. Ground water is 1 to 3 feet below the surface in wet periods. These soils formed under mixed hardwoods in sandy outwash deposits.

In a representative profile the surface layer is very dark grayish-brown fine sandy loam about 3 inches thick. The upper part of the substratum is light brownish-gray and brown loamy fine sand about 21 inches thick. The lower part is stratified strong-brown, reddish-yellow, and brown fine sand.

Tedrow soils have low available water capacity, rapid permeability, and low natural fertility.

Representative profile of Tedrow fine sandy loam, 0 to 3 percent slopes, in a cultivated field, NE¼SE¼ sec. 24, T. 14 N., R. 8 E.

A1—0 to 3 inches, very dark grayish brown (10YR 3/2) fine sandy loam; weak, medium, granular structure; very friable; slightly acid; abrupt, smooth boundary.

C1—3 to 6 inches, light brownish-gray (10YR 6/2) loamy fine sand; weak, medium, granular structure; very friable; slightly acid; abrupt, smooth boundary.

C2—6 to 15 inches, brown (7.5YR 5/4) loamy fine sand; common, fine, distinct, strong-brown (7.5YR 5/6) and light brownish-gray (10YR 6/2) mottles; weak, fine, granular structure; very friable; mildly alkaline; gradual, wavy boundary.

C3—15 to 24 inches, brown (7.5YR 5/4) loamy fine sand; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, granular structure; very friable; mildly alkaline; gradual, wavy boundary.

C4—24 to 33 inches, strong-brown (7.5YR 5/6) fine sand; many, medium, faint, yellowish-red (5YR 5/6) mottles; single grained; loose; mildly alkaline; gradual, wavy boundary.

C5—33 to 42 inches, reddish-yellow (7.5YR 6/6) fine sand; common, medium, faint, strong-brown (7.5YR 5/6) mottles; single grained; loose; mildly alkaline; gradual, wavy boundary.

C6—42 to 60 inches, brown (10YR 5/3) fine sand; common, fine, prominent strong-brown (7.5YR 5/6) mottles; single grained; loose; mildly alkaline.

The A1 horizon of Tedrow soils is loamy fine sand or fine sandy loam. In cultivated areas this layer is dark grayish-brown and about 8 inches thick. The C horizon is loamy fine sand or fine sand. Some areas of Tedrow soils have loam, silt loam, and sandy loam in the substratum.

Tedrow soils have a higher water table than Plainfield soils and mottles closer to the surface. Also, Tedrow soils are alkaline, but Plainfield soils are acid. The Tedrow soils have a lower water table than the Granby soils and less gleying in the profile. All of these soils are underlain by sandy outwash.

Tedrow loamy fine sand, 0 to 3 percent slopes (TdA).—This soil is in low areas. Many areas are large and extensive. Others are small and elongated or irregularly shaped. The profile of this soil has a coarser textured surface layer than the profile described as representative for the series.

This soil is susceptible to soil blowing where drained. In eroded areas the surface soil is thinner than in uneroded soils and the organic-matter content, fertility, and available water capacity are lower.

Drained areas of this soil are suited to the crops commonly grown in the county. (Capability unit IVw–5; woodland group 8; recreation group 4; wildlife group 5a)

Tedrow loamy fine sand, loamy substratum, 0 to 3 percent slopes (TeA).—This soil is in low areas. Its areas are generally irregular in shape. The profile of this soil is loamy in the substratum at a depth of more than 40 inches, and the profile described as representative for the series is fine sand between depths of 24 and 60 inches. In eroded areas the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to the crops commonly grown in the county. (Capability unit IVw–5; woodland group 8; recreation group 4; wildlife group 5a)

Tedrow fine sandy loam, 0 to 3 percent slopes (TfA).—This soil is in low areas. Many soil areas are large and extensive. Other areas are small and irregularly shaped. The profile of this soil is representative for the series.

This soil is susceptible to soil blowing where drained. Wetness is a hazard in undrained areas. Where drained and protected from soil blowing this soil is suited to most crops commonly grown in the county. (Capability unit IVw–5; woodland group 8; recreation group 4; wildlife group 5a)

Tedrow fine sandy loam, loamy substratum, 0 to 3 percent slopes (TlA).—This soil is in low areas. It has a loamy substratum at a depth of more than 40 inches.

Wetness is the main hazard to cultivation of this soil. Soil blowing also is a hazard in drained areas. Most drained areas are used for the crops commonly grown in the county. Undrained areas are used for woodland, pasture, and wildlife habitat. (Capability unit IVw–5; woodland group 8; recreation group 4; wildlife group 5a)

Wyocena Series

The Wyocena series consists of deep, well-drained, gently sloping to steep sandy and loamy soils. Ground water is more than 5 feet from the surface throughout the year. These soils formed under mixed hardwoods in sandy glacial till.

In a representative profile the surface layer is dark-brown loamy sand about 8 inches thick. The subsurface layer is about 2 inches of brown loamy sand that is slightly acid. The upper 5 inches of the subsoil is dark-brown heavy loamy sand about 5 inches thick, and the middle is reddish-brown and yellowish-red sandy loam about 16 inches thick. The lowest part of the subsoil is strong-brown sandy loam about 5 inches thick. The substratum is brown and strong-brown loamy sand and sand. Wyocena soils have low available water capacity, moderately rapid permeability, and medium natural fertility.

Representative profile of Wyocena loamy fine sand, 6 to 12 percent slopes, in a cultivated area, SW¼NW¼ sec. 34, T. 17 N., R. 10 E., 300 feet north and 100 feet west of a "T" intersection of unnamed county roads.

Ap—0 to 8 inches, dark brown (10YR 4/3) loamy sand; weak, fine, subangular blocky structure; very friable; plentiful roots; slightly acid; abrupt, smooth boundary.

A2—8 to 10 inches, brown (7.5YR 5/2) loamy sand; very weak, fine, subangular blocky structure; very friable to loose; plentiful roots; slightly acid; abrupt, wavy boundary.

B1—10 to 15 inches, dark-brown (7.5YR 4/4) heavy loamy sand; weak, fine, subangular blocky structure; very friable; few roots; slightly acid; clear, wavy boundary.

B21t—15 to 25 inches, reddish-brown (5YR 4/4) sandy loam; weak to moderate, fine subangular blocky structure; friable; few roots; clay bridging of sand grains; few thin films of clay on ped faces; slightly acid; clear, wavy boundary.

B22t—25 to 31 inches, reddish-brown (5YR 4/4) and yellowish-red (5YR 4/6) heavy sandy loam; moderate, fine, subangular blocky structure; slightly hard, friable; few thin clay films on ped faces; clay bridging of sand grains; medium acid; clear, wavy boundary.

B3t—31 to 36 inches, strong-brown (7.5YR 5/6) light sandy loam in the upper part and loamy sand in the lower part; weak, medium, subangular blocky structure; friable; thin clay bridging of sand grains; slightly acid; clear, wavy boundary.

C1—36 to 54 inches, brown (7.5YR 5/4) and strong-brown (7.5YR 5/6) loamy sand; single grained; loose; neutral to mildly alkaline in upper part and weakly calcareous at depth of 42 inches; gradual, smooth boundary.

C2—54 to 60 inches, strong-brown (7.5YR 5/6) and light-brown (7.5YR 6/4) medium sand and few, thin, dark-brown (7.5YR 4/4) bands of loamy sand; single grained; loose; moderately alkaline.

The Ap horizon of the Wyocena soils is loamy sand or sandy loam. The solum ranges from 24 to 36 inches in thickness. Very few to many stones are in the profile. The C horizon is more alkaline as depth increases and in many areas contains carbonates. Some areas of this soil have sandstone bedrock below the solum.

The Wyocena soils formed in loamy sand glacial till, but the associated Boyer soils formed in calcareous sand and gravel glacial outwash. They have a finer textured B horizon than the associated Gotham soils and are underlain by unsorted glacial till rather than the fine and medium sand of the Gotham soils. Wyocena soils have a thinner solum than the associated Mecan soils and generally are underlain by sandier glacial drift or till.

Wyocena loamy fine sand, 2 to 6 percent slopes (WoB).—This is a deep soil that occurs in irregularly shaped areas. Slopes are less than 300 feet long in most places.

The profile of this soil has a thicker combined surface layer and subsoil (about 40 inches thick) than the profile described as representative for the series.

Included with this soil in mapping are small, nearly level areas. Also included are moderately eroded areas.

This soil is susceptible to soil blowing and water erosion. In eroded areas the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower. This soil is suited to all the crops commonly grown in the county. (Capability unit IIIe–4; woodland group 4; recreation group 5; wildlife group 3)

Wyocena loamy fine sand, 6 to 12 percent slopes (WoC).—The slopes of this soil are less than 200 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil is representative for the series.

Included with this soil in mapping are areas that have complex rolling slopes and areas that are moderately eroded.

This soil is susceptible to soil blowing and moderate water erosion. In eroded areas, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all crops commonly grown in the county. (Capability unit IVe–4; woodland group 4; recreation group 5; wildlife group 3)

Wyocena loamy fine sand, 12 to 20 percent slopes (WoD).—The slopes of this soil are less than 200 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a somewhat thinner combined surface layer and subsoil (about 24 inches thick) than the profile described as representative for the series.

Included with this soil in mapping are areas of complex hilly slopes. Also included are areas that are moderately to severely eroded.

This soil is susceptible to soil blowing and water erosion, and some unprotected areas have been damaged by erosion. In eroded areas the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to pasture that has limited grazing. Renovation not more than once in 5 years is beneficial to pasture. Woodland and wildlife are also suitable uses. (Capability unit VIe–4; woodland group 4; recreation group 5; wildlife group 3)

Wyocena loamy fine sand, 20 to 30 percent slopes (WoE).—The slopes of this soil are less than 300 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a thinner combined surface layer and subsoil (about 20 inches thick) than the profile described as representative for the series.

Included with this soil in mapping are some moderately eroded areas.

This soil is very susceptible to soil blowing and water erosion. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to trees, wildlife, and recreation. Steep slopes make use of mechanical tree planters difficult. (Capability unit VIIe–4; woodland group 4; recreation group 5; wildlife group 3)

Wyocena fine sandy loam, 2 to 6 percent slopes (WyB).—The slopes of this soil are less than 300 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a slightly thicker combined surface layer and subsoil and a finer textured surface layer than the profile described as representative for the series.

Included with this soil in mapping are areas that are moderately eroded.

This soil is susceptible to soil blowing and water erosion. Where the thickness of the surface soil has been reduced by erosion, the organic-matter content, fertility, and available water capacity are lower than in uneroded areas.

Included with this soil in mapping are small moderately eroded areas and nearly level areas.

This soil is suited to all the crops commonly grown in the county. (Capability unit IIIe–4; woodland group 3; recreation group 5; wildlife group 1)

Wyocena fine sandy loam, 6 to 12 percent slopes, eroded (WyC2).—The slopes of this soil are less than 300 feet long in most places. Soil areas are generally irregular in shape. The profile of this soil has a thinner, lighter colored, finer textured surface layer than the profile described as representative for the series.

Included with this soil in mapping are areas in permanent pasture and woods that are only slightly eroded.

This soil is susceptible to water erosion and soil blowing. Where unprotected areas have been damaged by erosion, the surface soil is thinner than in uneroded areas and the organic-matter content, fertility, and available water capacity are lower.

This soil is suited to all the crops commonly grown in the county. (Capability unit IVe–4; woodland group 3; recreation group 5; wildlife group 1)

Yahara Series

The Yahara series consists of deep, somewhat poorly drained, nearly level, loamy soils in lacustrine basins and in long narrow drainageways of the bottom land. Ground water is 1 to 3 feet below the surface in wet seasons. These soils formed under mixed lowland hardwoods and grasses in glaciolacustrine silt and fine sand.

In a representative profile the surface layer is very dark grayish brown fine sandy loam about 10 inches thick. The upper 7 inches of the subsoil is mottled, yellowish-brown fine sandy loam and the middle 8 inches is light olive-gray fine sandy loam. The lower part of the subsoil is mottled, olive-colored loam about 8 inches thick. The substratum is olive loam stratified with silt and fine sand.

Yahara soils have high available water capacity, moderate permeability, and low natural fertility.

Representative profile of Yahara fine sandy loam, 0 to 3 percent slopes, in a cultivated field, NW¼NE¼ sec. 29, T. 16 N., R. 11 E.

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; weak, fine, granular structure; very friable; neutral; abrupt, smooth boundary.

B1—10 to 17 inches, yellowish-brown (10YR 5/4) fine sandy loam; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure; very friable; slightly acid; clear, smooth boundary.

B21g—17 to 25 inches, light olive-gray (5Y 6/2) silt and fine sand mixing to fine sandy loam; many, coarse, prominent, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable; slightly acid; gradual, smooth boundary.

B22g—25 to 33 inches, olive (5Y 5/6) loam; many, coarse, prominent, strong-brown (7.5YR 5/6) mottles; weak, medium, platy structure; friable; slightly acid; clear, smooth boundary.

Cg—33 to 60 inches, olive (5Y 5/3) loam stratified with silt and fine sand; many, medium, faint, light olive-gray (5Y 6/2) and prominent strong-brown (7.5YR 5/6) mottles; weak, medium, platy structure; moderately alkaline.

The Ap horizon is very dark brown, very dark grayish brown, or black. In some places these soils have thin textural bands less than 6 inches thick in the profile. The C horizon ranges from slightly acid to moderately alkaline.

The Yahara soils in most places in Marquette County are more acid than is the normal concept for the series, but this does not alter their usefulness or behavior.

Yahara soils have a loam subsoil rather than the silty clay loam subsoil of the Mundelein soils. They have a water table at a greater depth than the Keowns soils. All these soils formed in lacustrine deposits.

Yahara fine sandy loam, 0 to 3 percent slopes (YoA).—This soil is in low areas. Most soil areas are large and continuous on the landscape. Included with this soil in mapping is a soil that has a loam surface layer.

Yahara fine sandy loam is generally too wet for cultivation unless drained. Drained areas are suited to most of the crops commonly grown in the county. Under good management, continuous row crops can be grown (fig. 10). Undrained areas are used for woodland, wildlife, and pasture. (Capability unit IIw-4; woodland group 12; recreation group 4; wildlife group 5a)

Use and Management of the Soils

This section contains information about the use and management of the soils in Marquette County for crops and pasture, woodland, wildlife, and engineering. It explains the system of capability classification used by the Soil Conservation Service and gives predicted yields of principal crops grown in the county under a high level of management.

The section also groups the soils according to their suitability for woodland and wildlife habitat. It contains a table that groups the soils according to their suitability for recreational facilities and rates the limitations of these groups of soils. It also has a section that gives information significant in engineering.

Figure 10.—A good stand of corn on Yahara fine sandy loam, 0 to 3 percent slopes.

Use of the Soils for Crops

About 35 percent of Marquette County is cropland. The main crops are oats, alfalfa, and corn. Crops grown to a lesser extent are wheat, barley, rye, potatoes, sweet corn, and truck crops.

The following management practices apply to all soils in each capability unit. They are summarized and should be considered along with the practices suggested in each capability unit. To control erosion farmers can use terraces, diversions, contour stripcropping, or grassed waterways. Using such close-growing crops as small grain, grasses, and legumes in the cropping system also helps to control erosion.

Using a practice that adds organic matter to the soil improves tilth. Among these practices are plowing under a crop for green manure and plowing under crop residue. Surface, open ditch, or tile drainage is also needed on many soils in the county. Some soils are suited to all types of drainage, and others only to open ditch or surface drainage.

Applying lime and fertilizer in the amounts indicated by soil tests and field trials helps to correct soil acidity and to maintain fertility. The stands and growth of legumes generally are improved by liming. Poorly drained soils are generally alkaline and do not need lime, but supplemental applications are helpful on most soils if corn is grown after a nonleguminous crop.

Pasture renovation, where possible, improves pasture stands and growth if done no more than once each 5 years.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are so used, and the way they respond to treatment (*6*). The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, forest trees, or engineering.

In the capability system, the kinds of soil are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife. (None in Marquette County.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–2 or IIIe–4. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Marquette County are described and suggestions for the use and management of the soils are given. The capability unit for each soil mapped in the county is listed in the "Guide to Mapping Units."

CAPABILITY UNIT I–4

This unit consists of well-drained, deep, nearly level Sisson soils. These soils have a fine sandy loam or loam surface layer. They are moderately permeable and have high available water capacity. They also have medium natural fertility and good tilth, and they are easy to maintain.

These soils can be used intensively for corn, small grain, forage crops, and special crops. Row crops can be grown safely year after year if all crop residue is returned, minimum tillage is practiced, and a high level of fertility and good tilth are maintained.

CAPABILITY UNIT IIe–2

This unit consists of well-drained, deep and moderately deep, gently sloping Fox and Sisson soils. The surface layer is loam and fine sandy loam. These soils are moderately permeable, have medium to high available water capacity, and have medium natural fertility. Good tilth is fairly easy to maintain. The Fox soils in this unit have lower available water capacity than the other soils.

These soils are used mainly for corn, small grain, legumes, and grasses. Where cultivated, the soils are subject to damage by water erosion. Management practices that control erosion and maintain plant nutrients and organic matter are beneficial.

Where row crops are grown on these soils, stripcropping, growing cover crops, and using diversion terraces on long slopes help to control erosion. Runoff from adjacent higher soils can be diverted by constructing diversion terraces. Properly designed grassed waterways can be used to remove excess water safely and to prevent gullying.

Using a cropping system that includes several years of meadow crops helps to reduce erosion. Where conservation practices are not used, only one row crop can be grown safely in 4 or 5 years. Where conservation practices are used, row crops can be grown more frequently. Additional row crops can be used in the cropping system if large amounts of residue are returned, or if winter cover crops are grown and contour tillage is used. Larger amounts of residue are produced by growing hybrid corn that is heavily fertilized. The cornstalks can be shredded and spread over the soil to provide protection from erosion during winter and spring. When plowed under, the shredded cornstalks assist in maintaining organic-matter content and in promoting soil structure favorable to plant growth.

CAPABILITY UNIT IIe–6

This unit consists of well drained to moderately well drained, deep, gently sloping Briggsville and Montello soils. The surface layer of these soils is silt loam and loam. The soils are moderately slowly permeable. They have high available water capacity and a high natural fertility.

Where cultivated, soils in this unit are subject to damage by water erosion. Management practices that protect them from erosion and maintain plant nutrients and organic matter are beneficial.

These soils are used mainly for corn, small grain, legumes, and grasses. Where row crops are grown, stripcropping, growing cover crops, and using diversion terraces on long slopes help to control erosion. Runoff from adjacent higher areas can be diverted by constructing diversion terraces. Properly designed grassed waterways can be used to remove excess water safely and to prevent gullying.

Using a cropping system that includes several years of meadow crops in the rotation helps to control erosion. Where conservation practices are used, row crops can be grown more frequently. Additional row crops can be used in the cropping system if large amounts of residue are returned, or if winter cover crops are grown and contour tillage is used. Larger amounts of residue are produced where hybrid corn is heavily fertilized. The cornstalks can be shredded and spread over the soil to provide protection from erosion during winter and spring, and when plowed under, they assist in maintaining organic-matter content and in promoting soil structure favorable to plant growth.

CAPABILITY UNIT IIe–7

This unit consists of well-drained, deep, gently sloping Metea soils. The surface layer is fine sandy loam or loamy fine sand. These soils are moderately permeable. They have medium available water capacity and medium natural fertility. Good tilth is fairly easy to maintain.

These soils are used mainly for corn, small grain, legumes, and grasses. They also are suited to permanent pasture or woodland, and they provide food and cover for wildlife.

Where cultivated, soils in this unit are subject to damage by water erosion and soil blowing. Management practices such as grassed waterways, contour stripcropping, and diversion terraces help to protect these soils from erosion and to maintain plant nutrients and organic matter.

Using a cropping system that includes several years of meadow crops helps to control erosion. Where conservation is practiced, row crops can be grown more frequently. Additional row crops can be used in the cropping system if large amounts of residue are returned, or if winter cover crops are grown and contour tillage is used. Larger amounts of residue are produced where hybrid corn is heavily fertilized. The cornstalks can be shredded and spread over the soil to provide protection from erosion during winter and spring, and when plowed under, they assist in maintaining organic-matter content and in promoting soil structure favorable to plant growth.

CAPABILITY UNIT IIw–1

This unit consists of poorly drained, deep, nearly level Colwood and Poygan soils. These soils have a surface layer of silt loam, silty clay loam, or fine sandy loam. They are moderately permeable and slowly permeable, and they have high available water capacity and a medium natural fertility. Unless artificially drained, these soils are too wet for cultivation.

Soils in this unit are suitable for surface drainage or tile drainage. Where adequately drained, these soils are used mainly for corn, small grain, legumes, and grass. Row crops can be grown safely year after year where the organic-matter content and fertility are maintained at

a high level, minimum tillage is practiced, and good tilth and soil structure are maintained.

CAPABILITY UNIT IIw–2

This unit consists of somewhat poorly drained, deep, loamy, nearly level Mundelein and Mosel soils. These soils have a fine sandy loam, loam, or silt loam surface layer. They have moderately slow permeability and high available water capacity. Unless artificially drained, they are too wet for cultivation.

Soils in this unit are suitable for surface drainage or tile drainage. Where drained, these soils are used mainly for corn, small grain, legumes, and grass. Row crops can be grown year after year where the organic-matter content and fertility are maintained at a high level, minimum tillage is practiced, and good tilth and soil structure are maintained.

CAPABILITY UNIT IIw–4

This unit consists of somewhat poorly drained, deep, nearly level Yahara fine sandy loam, 0 to 3 percent slopes. This soil is moderately permeable, and it has high available water capacity and medium natural fertility. Unless artificially drained, it is too wet for cultivation.

Drained areas of this unit are used mainly for corn, small grain, legumes and grass. Tile drains do not function well in this soil, but open ditch and surface drainage can be used. Row crops can be grown safely year after year where the organic-matter content and fertility are maintained at a high level, minimum tillage is practiced, and good tilth and soil structure are maintained.

CAPABILITY UNIT IIw–8

This unit consists of very poorly drained, nearly level, deep Palms soils. These soils are shallow and deep mucky peat. They are moderately rapidly permeable in the upper part and moderately slowly permeable in the lower part. They have high available water capacity and low natural fertility. Unless drained, these soils are too wet for cultivation.

These soils are used for lettuce, spinach, onions, celery, carrots, mint, and similar crops. Corn and grass are also grown.

Tile drainage and open-ditch drainage are suitable methods of draining soils in this unit. Where drained and cultivated, these soils are subject to damage by blowing and subsidence. Management practices that protect them from soil blowing and that maintain plant nutrients and prevent subsidence are beneficial. In some areas truck crops are irrigated.

If these soils are drained and protected from soil blowing by windbreaks and wind stripcropping, row crops can be safely grown year after year. They are better suited to woodland or wildlife where drainage is not feasible.

CAPABILITY UNIT IIs–7

This unit consists of well drained and moderately well drained, deep, nearly level Briggsville, Metea, and Montello soils. The surface layer is fine sandy loam, loam, and silt loam. These soils are moderately permeable to moderately slowly permeable, and they have medium or high available water capacity. They have a wide range of natural fertility. Cultivation is sometimes delayed in the loam and silt loam soils of this unit because they dry out slowly in spring or after heavy rains. Systems that remove surface water are beneficial.

These soils are used mainly for corn, small grain, legumes, and grass. Where cultivated, the sandy loam soils are subject to soil blowing. Management practices such as planting windbreaks and wind stripcropping help to control erosion on the sandy soils.

Row crops can be grown safely year after year on the loamy soils where all crop residue is returned, a high level of fertility and good tilth are maintained, and minimum tillage is practiced.

CAPABILITY UNIT IIIe–2

This unit consists of well-drained, sloping and moderately steep soils that have a surface layer of loam or silt loam. These soils are in the Briggsville and Fox series. They have moderate or moderately slow permeability, moderate or high available water capacity, and medium natural fertility. The hazard of water erosion is moderate or severe.

These soils are used mainly for corn, small grain, legumes, and grass. They are subject to water erosion if cultivated. Management practices, such as stripcropping and using diversion terraces and grassed waterways, help to control erosion and to maintain plant nutrients and organic-matter content.

Using a cropping system that includes several years of meadow crops also helps to control erosion. Row crops can be grown safely in the cropping system where large amounts of residue are returned, or where winter cover crops are grown and tillage is used. Growing hybrid corn that is heavily fertilized produces larger amounts of cornstalks that can be shredded and spread over the soil to provide protection from erosion during winter and spring. Where residue is plowed under, it helps to maintain organic-matter content and to promote soil structure favorable to plant growth.

CAPABILITY UNIT IIIe–4

This unit consists of well drained and moderately well drained, gently sloping soils that have a surface layer of fine sandy loam, loam, and loamy fine sand. The soils are in the Casco, Delton, Lapeer, Pardeeville, Lorenzo, Mecan, Seward, and Wyocena series. They have slow, moderate, and moderately rapid permeability, low to medium available water capacity, and low to medium natural fertility. The hazards of water erosion and soil blowing are slight.

These soils are used mainly for corn, small grain, legumes, and grass. Where cultivated, the soils are subject to damage by soil blowing and water erosion. Contour stripcropping and use of grassed waterways, diversion terraces, and similar management practices can be used to help control erosion and to help maintain plant nutrients and organic-matter content.

Using several years of meadow crops in the cropping system also helps to reduce erosion. Row crops can be safely grown more frequently where large amounts of residue are returned, or where winter cover crops are grown and contour tillage is used. Growing hybrid corn that is heavily fertilized produces larger amounts of cornstalks that can be shredded and spread over the

soil to provide protection from erosion during winter and spring. If the residue is plowed under, it assists in maintaining organic-matter content and in promoting soil structure favorable to plant growth.

CAPABILITY UNIT IIIe-7

This unit consists of well-drained, deep, sloping Boyer, Oshtemo, Fox, and Metea soils. The surface layer is fine sandy loam, loamy fine sand, or sandy loam. These are moderately permeable and moderately rapidly permeable soils that are low to medium in available water capacity and medium in natural fertility. The hazard of water erosion is moderate and the hazard of soil blowing is moderate.

Soils in this unit are used mainly for corn, small grain, legumes, and grass. Where cultivated, these soils are subject to water erosion and soil blowing. Management practices, such as contour stripcropping and using diversion terraces and grassed waterways, help to control erosion and to maintain plant nutrients and organic-matter content.

Using a cropping system that includes several years of meadow crops also helps to control erosion. Row crops can be safely used in the cropping system if large amounts of residue are returned, or if winter cover crops are grown and contour tillage is used. Growing hybrid corn that is heavily fertilized produces large amounts of cornstalks that can be shredded and spread over the soil to provide protection from erosion during winter and spring. If plowed under, the residue helps to maintain organic-matter content and to promote soil structure favorable to plant growth.

CAPABILITYG UNIT IIIw-9

The only soil in this unit is very poorly drained, deep, nearly level Houghton mucky peat. This soil is moderately rapidly permeable, has very high available water capacity, and is low in natural fertility. Unless drained, this soil is too wet for cultivation.

This soil is used for lettuce, onions, spinach, carrots, celery, mint, and similar crops.

Open-ditch or tile drainage is suitable for this soil. Where drained and cultivated, this soil is subject to damage by soil blowing and subsidence. Management practices that help to control erosion and subsidence and that help to maintain plant nutrients are beneficial. Irrigation can be used for truck crops.

This soil is better suited to pasture, woodland, or wildlife than to cultivated crops if drainage is not feasible. If this soil is drained and protected from soil blowing by use of windbreaks and wind stripcropping, row crops can be grown safely year after year.

CAPABILITY UNIT IIIw-12

This unit consists of well drained and moderately well drained Ankeny soils and Alluvial land. These soils have moderate permeability to moderately rapid permeability and medium available water capacity. They are subject to occasional flooding.

Crops common in the county can be grown on Ankeny soils and Alluvial land, but the hazard of flooding should be considered. Where drainage is not feasible, pasture, woodland, or wildlife habitat are suitable uses.

CAPABILITY UNIT IIIs-2

This unit consists of well drained and moderately well drained Delton and Seward soils. These soils are deep, nearly level fine sandy loams that have a silty clay loam subsoil. They are slowly permeable, except in the upper part of the subsoil, where they are moderately rapidly permeable. These soils have medium available water capacity and low natural fertility. The growth of roots is restricted by the slowly permeable subsoil.

These soils are used mainly for corn, small grain, legumes, and grass. Growing occasional deep-rooted legumes and grass helps to overcome the slow permeability of the subsoil. Returning crop residue improves the natural fertility of the soils by adding organic matter. Fertilizing legumes and grasses as well as row crops increases the amount of plant residue that can be returned to the soil.

CAPABILITY UNIT IIIs-4

This unit consists of well-drained, deep, nearly level and gently sloping soils. These soils are in the Boyer, Fox, Lorenzo, and Oshtemo series, and the dark surface variant of the Boyer series is included. They have a loamy or sandy surface layer. These soils have moderate or moderately rapid permeability, low or medium available water capacity, and medium natural fertility. Droughtiness and soil blowing are the main hazards in cultivating these soils. The dark surface variant of the Boyer series and Lorenzo soils has a higher organic-matter content in the surface layer than the other soils.

Soils in this unit are used mainly for corn, small grain, legumes, and grass. Management practices, such as planting windbreaks, wind stripcropping, and minimum tillage, help control water erosion and soil blowing. More row crops can be grown on soils where this management is practiced than where erosion control practices are not used. Where irrigation, good residue management, and cover crops are used, row crops can be grown year after year.

CAPABILITY UNIT IVe-4

This unit consists of well-drained, shallow to deep, sloping soils that have a surface layer of fine sandy loam, loamy fine sand, and loamy sand. Soils of the Casco, Delton, Lapeer, Mecan, Pardeeville, and Wyocena series are in this unit. These soils have moderate to moderately rapid permeability and medium available water capacity and are low to medium in natural fertility. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Soils in this unit are used mainly to grow corn, small grain, legumes, and grass. They are too sloping and susceptible to erosion for intensive cropping. Row crops can be grown safely where erosion is controlled and good management practices, such as contour stripcropping, diversion terraces, or grassed waterways, are used.

The management of residue as mulch, use of cover crops, and maintenance of high levels of fertility and organic matter help control erosion and maintain tilth in these soils.

CAPABILITY UNIT IVe-7

This unit consists of well-drained, deep, moderately steep Boyer, Metea, and Oshtemo soils. The surface

layer is fine sandy loam and loamy fine sand. These soils are moderately permeable or moderately rapidly permeable, and they have a low or medium available water capacity and medium natural fertility. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

These soils are used for corn, small grain, and legumes. Trees, pasture, and food and cover for wildlife are also suitable uses.

The soils in this unit are too steep and susceptible to erosion for intensive cropping. Row crops cannot be grown safely on these soils; the soils are better suited to small grain, hay, or pasture.

Managing residue as mulch, using cover crops, and maintaining high levels of fertility and organic matter help to control erosion and maintain tilth.

CAPABILITY UNIT IVw–5

This unit consists of nearly level, somewhat poorly drained and poorly drained, loamy fine sand to fine sandy loam soils. These soils are in the Granby, Keowns, and Tedrow series, and Alluvial land, wet, is also included. These soils are moderately permeable to rapidly permeable, and they have low or medium available water capacity and low to moderate natural fertility. The Keowns soils in this unit have higher available water capacity than the other soils. Unless these soils are drained, excess water restricts use for crops.

Where drained, these soils are used for corn, small grain, or hay. Undrained areas are used for pasture, woodland, or wildlife food and cover.

Open-ditch or surface drainage can be used on these soils. Drained areas are susceptible to soil blowing. The cropping system can include more years of row crops and fewer years of small grain and legume hay if cover crops are grown, residue is used as mulch, minimum tillage is practiced, and a high level of fertility is maintained. Windbreaks can be substituted for residue mulching and growing a cover crop.

CAPABILITY UNIT IVw–7

This unit consists of nearly level, very poorly drained Adrian and Rollin soils and the stratified subsoil variant of the Adrian series. These soils are deep and shallow mucky peat. They are moderately rapidly permeable, have very high available water capacity, and are low in natural fertility. Their shallow depth and wetness are the main hazards.

Where drained, these soils are used mainly for corn or truck crops, such as lettuce, onion, spinach, carrots, celery, and mint. Open-ditch drainage is suitable. The shallow depth over sand, silt, and fine sand or marl is a severe hazard for tile drainage.

Controlling the water table helps to prevent unnecessary oxidation and subsidence. Irrigation can be used for truck crops. Wind strips, shelterbelts, or cover crops help to control soil blowing on drained, cultivated soils.

CAPABILITY UNIT IVs–3

This unit consists of deep loamy fine sands and fine sandy loams that are moderately well drained, well drained, and excessively drained. Nearly level to sloping Gotham, Moundville, Plainfield, and Wyocena soils are in this unit. These soils are moderately rapidly permeable to very rapidly permeable, have very low or low available water capacity, and are very low to medium in natural fertility. They are subject to severe soil blowing.

Soils in this unit are used for corn, small grain, legumes, and grass. The available water capacity is too low and these soils are too susceptible to soil blowing for intensive cropping. Row crops can be grown where well managed. Managing residue as mulch, using cover crops, and maintaining a high level of fertility and organic matter help control soil blowing.

CAPABILITY UNIT VIe–4

This unit consists of moderately steep, well-drained to excessively drained, shallow to deep soils that have a fine sandy loam and loamy fine sand surface layer. These soils are in the Casco, Gotham, Lapeer, Pardeeville, Mecan, and Wyocena series. They have moderate permeability to moderately rapid permeability, low or medium available water capacity, and are low or medium in natural fertility. Water erosion is the most severe hazard. The Pardeeville and Lapeer soils have slightly higher available water capacity than the other soils in this unit.

The soils in this unit are moderately steep and subject to water erosion and gullying. They cannot be used safely for cultivated crops. They are better suited to pasture, trees, recreation, or wildlife.

Careful management helps to establish and maintain vegetation for pasture or forage. Where these soils are used for forage, renovation is needed, but not more than once in 5 years. Topdressing each year can be substituted for renovation. Controlled grazing of pasture helps to maintain a good sod cover.

CAPABILITY UNIT VIs–3

This unit consists of nearly level to sloping, excessively drained, deep Plainfield sand and loamy fine sand and Wyocena loamy fine sand. These soils are moderately rapidly permeable or very rapidly permeable, have low available water capacity, and are low in natural fertility. Low available water capacity is the principal limitation to use of these soils. Soil blowing and water erosion also are limitations.

The soils in this unit are too sloping and too erodible to be used safely for crops. They are better suited to woodland, pasture, recreation, or wildlife habitat.

CAPABILITY UNIT VIIe–4

This unit consists of steep, well-drained, shallow to deep loamy fine sand and fine sandy loam soils. These soils are in the Boyer, Casco, Lapeer, Mecan, Pardeeville, and Wyocena series. They have moderate to moderately rapid permeability, low or medium available water capacity, and low to medium natural fertility. They are subject to severe water erosion.

The soils in this unit are too steep and erodible to be used safely for crops. They are better suited to pasture, woodland, recreation, or wildlife habitat.

Very careful management of these soils is necessary to establish and maintain vegetation for pasture or forage. The loamy fine sands have lower available water capacity and are more difficult to manage than other soils in the unit. Soils used for forage production need

to be renovated but not more than once in 5 years. Topdressing each year can be substituted for renovation. Controlled grazing of pasture helps to maintain a good sod cover.

Most areas of these soils are in trees. Where woodlots are properly managed and protected from fires, trees grow well.

CAPABILITY UNIT VIIw–10

The only soil in this unit is Houghton peat, acid variant, which is nearly level, very poorly drained, and deep. This soil is moderately rapidly permeable, has high available water capacity, and is low in natural fertility.

This soil is not used for crops. It is better suited to recreation, wildlife habitat, or nature study areas. The extremely acid reaction and difficulty in draining are the main limitations to use of this soil.

CAPABILITY UNIT VIIs–3

This unit consists of moderately steep to steep, excessively drained, deep, sandy soils of the Plainfield and Wyocena series. These soils are very rapidly permeable to moderately rapidly permeable, have low available water capacity, and are low in natural fertility. The main limitations to use of these soils are their low available water capacity and susceptibility to soil blowing and water erosion.

Soils in this unit are mostly in trees, and they can be used as food and cover areas for wildlife. Protection from fire and careful management are very important to protect these soils from blowing and water erosion. Trees and other vegetation are difficult to establish on these soils. Steep slopes make it difficult to use mechanical tree planters on most of these soils.

CAPABILITY UNIT VIIs–9

The only soil in this unit is Steep sandy land. It consists of steep and very steep, excessively drained, deep, sandy areas. These areas are very rapidly permeable, have low available water capacity, and are low in natural fertility. The main hazards are low available water capacity and extreme susceptibility to soil blowing and water erosion.

Steep sandy land is too susceptible to soil blowing and water erosion to be used safely for crops. The vegetative cover is so sparse that erosion is active. Special efforts are needed to establish vegetation. Planting trees and protecting them from mismanagement and fire help to control erosion.

CAPABILITY UNIT VIIIw–15

This unit consists only of Marsh. Areas of Marsh are in lowlands that are flooded most of the time. These areas generally are not suitable for drainage. They are small depressions and very low areas along lakes and streams. The vegetation is cattails, sedges, and reeds.

This soil is better suited to wildlife and recreation than to other uses.

Predicted yields

The predicted average acre yields of principal field and forage crops are given in table 2. These predictions were based on information from farmers, on results obtained by the staff of the agricultural experiment stations, and on observations made by soil scientists, the district conservationist, and other farm workers who are familiar with the soils of the county.

Table 2 lists yields to be expected under a high level of management. This management includes liming and fertilization as needed each year, the use of suitable species and varieties, the use of conservation practices, and attention to proper grazing practices.

The predicted yields in table 2 can be used as a check to see if present management practices are adequate, and to help in determining the kind of management that will give the desired yields. Consult your county agent or the nearest experiment station for specific suggestions about the kinds and amounts of fertilizer, lime, and seeding mixtures to use.

Woodland Uses of the Soils [2]

Woodland in Marquette County covers about 86,000 acres, or 30 percent of the land area. Most of this acreage is in farm woodlots. Before settlement, the county was about 70 percent forested, but logging and clearing for farm use have greatly reduced the acreage (*8*).

Most of the existing woodland is mixed upland oaks: red oak, black oak, white oak, and northern pin oak. Natural stands of the conifers white pine, jack pine, red pine, and tamarack grow on less than 10 percent of the forested acreage. Tamarack grows on 8,700 acres.

Tree growth in the county is below the potential of the soils. Production is low because of poor management, understocking, high percentage of low quality trees, and grazing wooded areas. An estimated two-thirds of the woodland was understocked, according to the 1954 Forest Inventory.

As a help to foresters and others managing woodland, the soils of Marquette County have been placed in woodland suitability groups. The soils in each group are similar in growth potential and hazards to the establishment, survival, management, and harvest of trees.

Potential productivity is expressed in the descriptions of the woodland groups in terms of site index. Site index for many of the soils was determined from measurements made by foresters and soil scientists working together. Where a woodland site was not available for measurements on a specified soil, a site index on a similar soil was used for comparison. The site index is the average height that dominant trees can be expected to reach in 50 years on a specified soil. It depends largely on the capacity of the soil to furnish moisture and growing space for roots.

Seedling mortality refers to the expected loss of seedlings as a result of unfavorable characteristics of the soil. A mortality rating of *slight* indicates that a loss of not more than 25 percent of the seedlings is expected, or that trees ordinarily regenerate naturally in places where there are adequate sources of seed. A rating of *moderate* indicates that a loss of 25 to 60 percent of the seedlings is expected, or that the trees do not regenerate naturally in numbers needed for adequate restocking. In some places replanting to fill open spaces is necessary. A

[2] By Robert Greenlaw and George Alley, foresters, Soil Conservation Service.

TABLE 2.—*Predicted average yields per acre of principal crops*

[Absence of a yield figure indicates that the soil is not suited to the crop or that the crop ordinarily is not grown. Soils and land types that are unsuitable for the crops shown are not listed in this table]

Soil	Corn	Oats	Alfalfa-brome hay	Alfalfa-brome pasture
	Bu	*Bu*	*Tons*	*A.U.D.*[1]
Adrian mucky peat, deep	90		3. 0	(2)
Adrian mucky peat, shallow				(2)
Adrian mucky peat, deep, stratified subsoil variant	90		3. 0	(2)
Adrian mucky peat, shallow, stratified subsoil variant				(2)
Alluvial land	65	40		135
Alluvial land, wet				80
Ankeny fine sandy loam	80	65	3. 0	120
Boyer fine sandy loam, 2 to 6 percent slopes	68	53	2. 0	110
Boyer fine sandy loam, 6 to 12 percent slopes, eroded	52	46	2. 0	100
Boyer fine sandy loam, 12 to 20 percent slopes, eroded	45	40	1. 5	75
Boyer loamy fine sand, 2 to 6 percent slopes	58	50	2. 0	110
Boyer loamy fine sand, 6 to 12 percent slopes, eroded	50	42	2. 0	110
Boyer loamy fine sand, 12 to 20 percent slopes, eroded			1. 5	90
Boyer-Oshtemo loamy sands, 2 to 6 percent slopes:				
Boyer part	58	50	2. 0	110
Oshtemo part	58	50	2. 0	100
Boyer-Oshtemo loamy sands, 6 to 12 percent slopes, eroded:				
Boyer part	50	42	2. 0	110
Oshtemo part	50	42	2. 0	100
Boyer fine sandy loam, dark surface variant, 0 to 2 percent slopes	70	55	2. 5	110
Boyer fine sandy loam, dark surface variant, 2 to 6 percent slopes	68	53	2. 5	110
Boyer fine sandy loam, dark surface variant, 6 to 12 percent slopes, eroded	52	46	2. 0	90
Briggsville loam, 0 to 2 percent slopes	95	85	4. 5	160
Briggsville loam, 2 to 6 percent slopes	92	80	4. 5	160
Briggsville loam, 6 to 12 percent slopes, eroded	85	75	4. 0	160
Briggsville loam, 12 to 20 percent slopes, eroded	75	50	3. 5	140
Briggsville silt loam, 0 to 2 percent slopes	100	90	4. 5	160
Briggsville silt loam, 2 to 6 percent slopes	95	85	4. 5	160
Casco fine sandy loam, 2 to 6 percent slopes	68	53	2. 75	100
Casco fine sandy loam, 6 to 12 percent slopes, eroded	52	46	2. 0	90
Casco fine sandy loam, 12 to 20 percent slopes, eroded			1. 5	80
Casco fine sandy loam, 20 to 30 percent slopes, eroded				80
Colwood fine sandy loam	90	65	3. 5	140
Delton fine sandy loam, 0 to 2 percent slopes	80	60	3. 0	120
Delton fine sandy loam, 2 to 6 percent slopes	78	58	3. 0	120
Delton fine sandy loam, 6 to 12 percent slopes, eroded	70	50	2. 5	110
Delton loamy fine sand, 1 to 6 percent slopes	70	50	2. 5	110
Delton loamy fine sand, 6 to 12 percent slopes, eroded	65	45	2. 0	100
Fox loam, 2 to 6 percent slopes	80	60	3. 0	130
Fox loam, 6 to 12 percent slopes, eroded	65	50	2. 5	120
Fox sandy loam, 2 to 6 percent slopes	65	55	2. 75	130
Fox sandy loam, 6 to 12 percent slopes, eroded	58	48	2. 3	120
Gotham fine sandy loam, 0 to 2 percent slopes	62	58	2. 8	120
Gotham fine sandy loam, 2 to 6 percent slopes	60	55	2. 5	120
Gotham fine sandy loam, loamy substratum, 1 to 3 percent slopes	62	58	2. 8	100
Gotham loamy fine sand, 0 to 2 percent slopes	60	55	2. 0	100
Gotham loamy fine sand, 2 to 6 percent slopes	58	50	2. 0	100
Gotham loamy fine sand, 6 to 12 percent slopes	50	45	1. 5	90
Gotham loamy fine sand, 12 to 20 percent slopes			1. 0	80
Gotham loamy fine sand, loamy substratum, 0 to 2 percent slopes	60	55	2. 5	120
Gotham loamy fine sand, loamy substratum, 2 to 6 percent slopes	58	52	2. 0	120
Gotham loamy fine sand, loamy substratum, 6 to 12 percent slopes, eroded	50	45	1. 5	110
Gotham loamy fine sand, loamy substratum, 12 to 20 percent slopes, eroded				100
Granby fine sandy loam	55	50	3. 0	120
Granby fine sandy loam, loamy substratum	60	50	3. 0	120
Granby loamy fine sand	52	48	2. 8	110
Houghton mucky peat		100	3. 0	120
Keowns fine sandy loam	80	53	3. 0	130
Lapeer-Pardeeville fine sandy loams, 2 to 6 percent slopes	80	70	2. 5	110
Lapeer-Pardeeville fine sandy loams, 6 to 12 percent slopes, eroded	65	55	1. 8	110
Lapeer-Pardeeville fine sandy loams, 12 to 20 percent slopes, eroded			1. 5	90
Lapeer-Pardeeville fine sandy loams, 20 to 30 percent slopes, eroded				80
Lorenzo loam, 0 to 2 percent slopes	75	60	2. 8	120
Lorenzo loam, 2 to 6 percent slopes	70	55	2. 5	120
Mecan fine sandy loam, 2 to 6 percent slopes	70	55	2. 0	100
Mecan fine sandy loam, 6 to 12 percent slopes, eroded	52	46	2. 5	90
Mecan loamy fine sand, 12 to 20 percent slopes, eroded			1. 60	70

See footnotes at end of table.

TABLE 2.—*Predicted average yields per acre of principal crops*—Continued

Soil	Corn	Oats	Alfalfa-brome hay	Alfalfa-brome pasture
	Bu	*Bu*	*Tons*	*A.U.D.*[1]
Mecan loamy fine sand, 20 to 30 percent slopes, eroded			1. 5	70
Metea fine sandy loam, 2 to 6 percent slopes	80	75	4. 2	150
Metea fine sandy loam, 6 to 12 percent slopes	75	70	3. 0	140
Metea fine sandy loam, 12 to 20 percent slopes, eroded	65	60	2. 25	120
Metea fine sandy loam, sandy substratum, 2 to 6 percent slopes	80	75	3. 5	150
Metea fine sandy loam, sandy substratum, 6 to 12 percent slopes, eroded	75	70	3. 5	140
Metea fine sandy loam, stratified substratum, 0 to 2 percent slopes	90	85	4. 5	160
Metea fine sandy loam, stratified substratum, 2 to 6 percent slopes	85	80	4. 25	150
Metea fine sandy loam, stratified substratum, 6 to 12 percent slopes	80	75	4. 0	140
Metea loamy fine sand, 2 to 6 percent slopes	70	65	3. 0	120
Metea loamy fine sand, 6 to 12 percent slopes, eroded	60	50	1. 8	100
Metea loamy fine sand, 12 to 20 percent slopes	55	45	1. 5	75
Metea loamy fine sand, sandy substratum, 2 to 6 percent slopes	60	48	1. 8	140
Metea loamy fine sand, sandy substratum, 6 to 12 percent slopes, eroded	55	40	1. 8	140
Montello loam, 0 to 2 percent slopes	95	85	4. 5	200
Montello loam, 2 to 6 percent slopes	92	80	4. 0	200
Montello silt loam, 0 to 2 percent slopes	100	90	4. 5	200
Montello silt loam, 2 to 6 percent slopes	95	85	4. 0	200
Mosel fine sandy loam, 0 to 3 percent slopes	80	60	3. 5	150
Mosel loam, 0 to 3 percent slopes	85	65	3. 8	150
Moundville fine sandy loam, 0 to 3 percent slopes	62	58	2. 8	140
Moundville loamy fine sand, 0 to 3 percent slopes	60	55	2. 5	120
Mundelein loam, 0 to 3 percent slopes	95	68	3. 5	150
Mundelein silt loam, 0 to 3 percent slopes	100	70	3. 5	150
Oshtemo fine sandy loam, 0 to 2 percent slopes	70	55	2. 5	110
Oshtemo fine sandy loam, 2 to 6 percent slopes	68	53	2. 0	110
Oshtemo fine sandy loam, 6 to 12 percent slopes, eroded	52	46	2. 0	100
Oshtemo loamy fine sand, 0 to 2 percent slopes	65	55	2. 0	100
Oshtemo loamy fine sand, 2 to 6 percent slopes	58	50	2. 0	100
Oshtemo loamy fine sand, 6 to 12 percent slopes, eroded	50	42	2. 0	100
Oshtemo loamy fine sand, 12 to 20 percent slopes, eroded			1. 5	90
Palms mucky peat, deep	100		3. 0	(2)
Palms mucky peat, shallow	100		3. 0	(2)
Plainfield loamy fine sand, 0 to 2 percent slopes	45	35	1. 5	60
Plainfield loamy fine sand, 2 to 6 percent slopes	40	32	1. 5	60
Plainfield loamy fine sand, 6 to 12 percent slopes			. 9	60
Plainfield-Wyocena complex, 2 to 6 percent slopes:				
Plainfield part	40	32	1. 5	60
Wyocena part	58	50	2. 5	100
Plainfield-Wyocena complex, 6 to 12 percent slopes:				
Plainfield part			. 9	60
Wyocena part	50	42	2. 0	90
Poygan fine sandy loam	95	70	4. 0	140
Poygan silty clay loam	95	70	4. 0	140
Rollin mucky peat				(2)
Seward fine sandy loam, 0 to 2 percent slopes	80	60	3. 0	120
Seward fine sandy loam, 2 to 6 percent slopes	78	58	3. 0	120
Sisson fine sandy loam, 0 to 2 percent slopes	85	80	4. 5	160
Sisson fine sandy loam, 2 to 6 percent slopes, eroded	75	75	4. 2	150
Sisson loam, 0 to 2 percent slopes	92	85	4. 5	160
Sisson loam, 2 to 6 percent slopes	90	80	4. 0	140
Tedrow fine sandy loam, 0 to 3 percent slopes	60	60	2. 0	100
Tedrow fine sandy loam, loamy substratum, 0 to 3 percent slopes	65	65	2. 5	100
Tedrow loamy fine sand, 0 to 3 percent slopes	55	50	2. 0	100
Tedrow loamy fine sand, loamy substratum, 0 to 3 percent slopes	60	60	2. 0	100
Wyocena fine sandy loam, 2 to 6 percent slopes	68	53	3. 0	120
Wyocena fine sandy loam, 6 to 12 percent slopes, eroded	55	50	2. 5	110
Wyocena loamy fine sand, 2 to 6 percent slopes	58	50	2. 5	100
Wyocena loamy fine sand, 6 to 12 percent slopes	50	42	2. 0	90
Wyocena loamy fine sand, 12 to 20 percent slopes			1. 5	80
Yahara fine sandy loam, 0 to 3 percent slopes	80	60	3. 0	130

[1] A.U.D. stands for animal-unit-day, or the amount of forage consumed in 1 day by 1 animal unit. An animal unit is equivalent to a 1,000-pound beef cow and calf, a 1,000-pound dairy cow that produces 25 pounds of 4-percent milk from pasture, 2 yearling cattle, or 5 mature sheep.

[2] These soils are capable of producing adequate amounts of forage plants, but where they are used for pasture they are severely damaged by trampling of livestock.

rating of *severe* indicates that a loss of more than 50 percent of the seedlings is expected, or that trees do not regenerate naturally.

Plant competition refers to competition from undesirable trees and shrubs that invade the site and hinder the establishment and growth of desirable trees after the woodland has been disturbed by cutting. Competition is *slight* if undesirable species are no special problem. It is *moderate* if the invaders delay but do not prevent the natural regeneration of desirable plants and if simple methods prevent undesirable trees from invading. Competition is *severe* if trees cannot regenerate naturally. If seedlings are planted, undesirable plants must be controlled by carefully preparing the site and using intensive woodland management.

Equipment limitation refers to the limitation on the use of ordinary equipment caused by unfavorable soil characteristics and topography. Some of the unfavorable characteristics that limit the use of equipment are poor drainage, stones, rocks, and steep slopes. The limitation is *slight* if there are no special problems in use of equipment. It is *moderate* if not all types of equipment can be used at all times, if the periods when wetness or a high water table restricts the use of equipment are not longer than 3 months, or if use of equipment damages the roots of trees to some extent. It is *severe* if many types of equipment cannot be used, if periods when wetness or a high water table restricts the use of equipment are longer than 3 months, or if the use of equipment seriously damages the roots of trees and the structure and stability of the soil.

Windthrow hazard is related to soil characteristics that affect the development of the tree roots and the firmness with which the roots anchor the tree in the soil. The hazard is *slight* if the roots hold the trees firmly against a normal wind. It is *moderate* if the trees are not subject to windthrow except when the soil is excessively wet or the wind velocity very high. It is *severe* if root development is not deep enough to give adequate stability and individual trees are likely to be blown over if they are released on all sides.

Erosion hazard refers to the risk of erosion on well-managed woodland that is not protected by special practices. It is slight where a small loss of soil is expected. Generally, erosion is *slight* if slopes range from 0 to 2 percent and runoff is slow or very slow. The erosion hazard is *moderate* where there is a moderate loss of soil, runoff is not controlled, and the vegetative cover is adequate for protection. It is *severe* where steep slopes, rapid runoff, slow infiltration and permeability, and past erosion make the soil susceptible to severe erosion.

In the following pages each of the woodland groups in Marquette County is described. The groups are numbered according to a statewide system. Groups 2 and 6 of this system are not represented in this county. The names of the soil series represented are mentioned in the description of each group, but this does not mean that all of the soils of a given series are in that group. The woodland group of each soil mapped in the county is given in the "Guide to Mapping Units."

WOODLAND GROUP 1

This group consists of moderately deep or deep, moderately well drained or well drained soils. The surface layer is medium textured in the Briggsville, Fox, Sisson, and Ankeny soils and moderately coarse textured in the Delton, Fox, Lapeer, Pardeeville, and Seward soils. The foregoing soils make up this woodland group.

The native vegetation is mixed hardwoods. Northern red oak is the most important and most commonly occurring species. Sugar maple and basswood in lesser amounts and aspen that appears on burned areas and openings are also important species.

Potential for tree growth is good by Wisconsin standards. The measured site index for red oak is 55 to 65 (*5*). Because these soils are highly desirable for field crops, extensive wooded areas are few.

Plant competition from weeds, grass, and brush and seedling mortality are severe hazards. The moderately coarse textured soils tend to dry out at the surface and this leads to mortality of newly planted trees if dry weather follows planting.

If weather is normal, trafficability of these soils is good and there is slight limitation to use of equipment. The hazard of windthrow is slight because depth of root zones is adequate. Soil erosion is generally a moderate hazard on steep slopes, but it is severe where the soil is bare, as in a new plantation.

Species preferred for reforestation are white pine, red pine, and white spruce. White pine, white spruce, and northern white-cedar are well suited to use in windbreak plantings.

WOODLAND GROUP 3

This group consists of moderately deep or deep, moderately coarse textured, well drained and moderately well drained soils. These soils are of the Boyer, Delton, Gotham, Mecan, Metea, Moundville, Oshtemo, and Wyocena series.

The native vegetation is mixed oak; red, white, and jack pines; aspen; and paper birch.

The potential for tree growth is generally high for pines and low for oaks, the most important species economically. Site index has been measured at 70 to 75 for red pine and about 45 for oaks.

Droughtiness is a moderate to severe hazard to seedling establishment, especially on south- and west-facing slopes. Soil blowing is a hazard in unprotected areas.

Red, white, and jack pines are well suited to reforestation or to windbreak plantings on soils of this group.

WOODLAND GROUP 4

This group consists of excessively well drained and moderately well drained, coarse-textured soils. These soils are of the Boyer, Gotham, Metea, Moundville, Oshtemo, Plainfield, and Wyocena series and Steep sandy land (fig. 11). The native woodland vegetation is jack pine, northern pin oak, and black oak.

Pines generally grow faster on these soils than the oaks. Measured site indices are approximately 67 to 80 for red pine, 65 to 80 for white pine, 50 to 66 for jack pine, and 39 to 64 for upland oak, black and northern

Figure 11.—Scrub oak on a landscape in woodland group 4. Soils are of the Plainfield and Gotham series.

pin oak in this instance. These fairly wide ranges probably reflect measurements taken on deteriorated soil sites.

Seedling mortality is severe because the available water capacity of these soils is poor. The erosion hazard is severe if these soils are left unprotected. Red pine, white pine, and jack pine are suitable species for reforestation or windbreak plantings.

WOODLAND GROUP 5

This group consists of shallow, well-drained, moderately coarse textured Casco soils. The native trees on these soils are mostly upland oak, black oak, and northern pin oak. A few aspen, eastern redcedar, and white pine mingle with the oaks.

Soil productivity is fairly low for tree growth. The site index for white pine is 48 to 49 and for upland oak is 39 to 50.

The shallow soils of this group tend to be fairly droughty and to have a severe seedling mortality. Equipment use is limited by steep slopes and irregular topography that are common for many Casco soils.

Windthrow is only moderate despite the shallow root zones of these soils because the native species have tap roots and resist windthrow. The erosion hazard is severe on steeper slopes.

White pine is suited to plantings on the cooler sites, on north- and east-facing slopes, and in protected areas. Red pine plantings are not advisable, because the level of calcium is high in the underlying stratum, except where quick cover is desired and there is little regard for later vigorous growth. Eastern redcedar is the only tree suited to planting on south- and west-facing steep slopes and in areas of very thin soil.

WOODLAND GROUP 7

This group consists of soils of uplands. These soils are somewhat poorly drained to very poorly drained. They are medium-textured or moderately fine textured soils of the Colwood, Keowns, Mundelein, Poygan, and Mosel series. The native trees growing on these soils are predominantly soft maple, elm, ash, willow, and northern white-cedar.

Measured site indices are 79 for soft maple, 63 to 69 for white ash, 40 for northern white-cedar, and 60 to 70 for American elm. Generally the somewhat poorly drained Mundelein and Mosel soils have more tree growth than the other soils, which are wetter.

Plant competition from weeds and brush is severe, and threat of drownout is a severe hazard to seedling establishment and survival. Wetness is a severe limita-

tion to use of equipment, especially during spring. Windthrow is a severe hazard because of the limited depth of root zones. Butt rot and other fungus infections are severe hazards, especially on the wetter soils.

Suitable tree species for reforestation are white spruce, northern white-cedar, and soft maple. On the drier sites white pine grows well. The poorly drained soils are not suited to tree plantings, unless the soils have been artificially drained.

WOODLAND GROUP 8

This group consists of moderately coarse textured or coarse-textured, somewhat poorly drained or poorly drained Tedrow and Granby soils. Native tree species are elm, soft maple, ash, some northern white-cedar, and some aspen.

Site index is 66 to 75 for aspen; 49 to 55 for red pine; and 50 for jack pine.

Severe hazards to seedling establishment are plant competition and danger of drownout. Windthrow hazard is moderate to severe, and the use of equipment is moderately limited.

White pine and northern white-cedar are suitable species for planting. White ash and soft maple are generally favored in management of natural stands.

WOODLAND GROUP 9

This group consists of Alluvial land and Alluvial land, wet. These land types are made up of somewhat poorly drained to very poorly drained alluvial soils.

Native tree species are elm, ash, soft maple, willow, and other wetland hardwoods. Site quality as reflected by tree growth ranges from poor to good, depending on wetness. No site index measurements have been made on these soils.

Plant competition and seedling mortality from drown out are severe. Because trafficability is poor during wet periods, limitations to use of equipment are severe. Butt rot and other diseases associated with wet sites are a moderate to severe hazard.

Cottonwood, northern white-cedar, and soft maple are suitable for reforestation. In some places willows are planted along streams to stabilize banks and are well suited to this use.

WOODLAND GROUP 10

This group consists of peat and mucky peats. These soils are of the Adrian, Adrian, stratified subsoil variant, Houghton, Houghton, acid variant, Palms, and Rollin series.

The native vegetation ranges from tree species, such as tamarack, ash, elm, maple, willow, and northern white-cedar, to brushy species, such as tag elder and the marsh grasses and sedges. Tamarack is probably the most important species for forestry purposes.

The measured site index for tamarack ranges from 47 to 53, for red maple is 65, and northern white-cedar ranges from 29 to 41 (*5*). Site quality varies a great deal with soil character, moisture content, and other factors.

Drownout, plant competition, and frost combine to create a severe hazard to seedling establishment and survival. The windthrow hazard is severe, and use of equipment is severely limited. A severe hazard is caused by root rot, butt rot, and other diseases associated with wet soils.

Tree planting is difficult. It is practiced in only a few places on these soils, except for windbreak plantings around crop fields. Various willows and poplars are well suited for these plantings.

WOODLAND GROUP 11

Only the land type, Marsh, is in this group. Native vegetation is limited to marsh grasses and sedges, cattails, and similar plants.

The soils are not suited to growing of trees.

WOODLAND GROUP 12

This group consists of medium-textured and moderately coarse textured, somewhat poorly drained to well-drained prairie soils that formed under grasses. These soils are of the Boyer, dark surface variant, Lorenzo, Montello, and Yahara series. The native vegetation on these soils is prairie grasses and scattered oaks. Trees are mainly bur oak, white oak, red oak, black oak, and a few eastern redcedars.

Site index measurements have not been made on soils of the group, because measurable trees do not grow in forest stands.

The main hazard to tree establishment and survival is plant competition. The erosion hazard on sloping soils is moderate to severe.

A wide range of tree species is suited to windbreak plantings on the soils of this group. All these soils except those in the Yahara series are well drained and provide good sites for white pine; white, Norway, and Black Hills spruce; and northern white-cedar. The steep, hot sites are suited to eastern redcedar. Trees that grow well on wet soils, such as northern white-cedar, white spruce, willows, and cottonwoods, grow well on the Yahara soils. These soils are reforested in only a few places, because they are highly valuable for crops.

Use of the Soils for Recreation

Many areas of Marquette County are suitable for recreation sites. Among the soil properties that affect the use of soils for this purpose are texture, permeability, steepness of slope, depth to bedrock, wetness, and the hazards of erosion and flooding. On the basis of these and related soil characteristics, soils that have similar properties have been placed in groups and rated for specified recreational purposes. The recreation group for each soil mapped in the county is listed in the "Guide to Mapping Units." The ratings and soil limitations that influence these ratings are given in table 3. Although esthetics and other features are important to planning, they are not considered in these ratings. In general, severely eroded soils have a more severe rating than the soils listed in the table.

Ratings are slight, moderate, severe, or very severe. A rating of *slight* means that the soil has no limitations or has limitations for a given use that are easy to overcome. A rating of *moderate* means that limitations can be overcome by average management and careful design. A rating of *severe* means that the soil has limitations for a given use that are difficult to overcome. A rating of *very severe* means that the soil has limitations that generally preclude its use for the specified purpose.

Following are explanations of limitations of soils for uses specified in table 3 and the rating of recreational facilities.

Playgrounds, athletic fields, and intensive play areas are used for organized sports such as baseball, football, tennis, and other games that subject the soil to heavy foot traffic. The ideal soil for this purpose is nearly level, well drained, and firm, and it provides good traction when moist. An adequate cover of vegetation can be produced and maintained.

Wetness or internal drainage is important because the surface of some soils remains wet for long periods after rains. Other soils drain quickly and can be used within a short time after the rain stops falling. Flooding is relatively unimportant if it lasts only a short time and occurs during periods of nonuse. Permeability of the soil affects the rate at which the surface dries after rains by determining the amount of water that can enter the soil and move into the lower part of the profile. It is difficult to manipulate sloping or steep soils to provide sufficient area for playgrounds and athletic fields. The texture of the surface layer affects trafficability if the soil is very dry or very moist. It also affects the hazard of soil blowing. Depth to bedrock, stoniness, rockiness, and other features affect the use of the soils for intensive play areas.

Picnic areas have requirements similar to parks and extensive play areas. In general, these uses are not as intensive as for athletic fields and do not involve regularly scheduled events. These areas therefore can be subject to occasional flooding, can be more sloping, and can have a relatively higher water table than is permissible for athletic fields. Stones and rocks on the surface are not important unless they are numerous or large.

Wetness or internal drainage is important. The poorly drained and very poorly drained soils and in some places the somewhat poorly drained soils are subject to ponding and are too wet for use for several weeks during the picnic season. Flooding is important during the season of use. Areas that have slopes up to 12 percent can be used for picnic sites; but moderately steep, steep, and very steep soils (slopes of more than 12 percent) are very difficult to use for this purpose. Soil texture as related to trafficability, blowing dust, and slipperiness when wet is important for picnic areas. In general, clay, sand, and organic soils are least desirable. Sandy loam and loam soils are most desirable.

Paths and trails are bridle paths, nature trails, and hik-

TABLE 3.—*Degree and kinds of limitations*

Recreational group and soils	Playgrounds, athletic fields, and intensive play areas	Picnic areas
1. Very poorly drained organic soils of the Adrian; Adrian, stratified subsoil variant; Houghton; Houghton, acid variant; Palms; and Rollin series; and Marsh.	Very severe: high water table; low trafficability; sod easily damaged; susceptible to soil blowing.	Very severe: high water table; low trafficability when wet; sod easily damaged; susceptible to soil blowing.
2. Well-drained, nearly level to very steep, loamy soils of the Fox, Lapeer, Lorenzo, and Pardeeville series.	Slight where slope is 0 to 2 percent; moderate where slope is 2 to 6 percent; severe where slope is 6 to 12 percent; very severe where slope is 12 to 30 percent: erodible on slopes; compacts easily when wet; extensive leveling may expose the sand and gravel or sandy loam substratum.	Slight where slope is 0 to 6 percent; moderate where slope is 6 to 12 percent; severe where slope is more than 12 percent: unprotected areas are susceptible to erosion.
3. Poorly drained, deep, nearly level soils of the Colwood, Granby, Keowns, and Poygan series; and Alluvial land, wet.	Severe: high water table; low trafficability when wet; sod easily damaged; periodic flooding along streams and rivers; compacts easily when wet.	Severe: high water table; low trafficability when wet; sod easily damaged; periodic flooding along streams and rivers; compacts easily when wet.
4. Somewhat poorly drained, deep, nearly level to gently sloping soils of the Mosel, Mundelein, Tedrow, and Yahara series.	Moderate: seasonal high water table; compacts easily when wet; extensive leveling exposes sand and gravel substratum.	Moderate: seasonal high water table; compacts easily when wet.
5. Excessively drained, well drained and moderately well drained, shallow to deep, nearly level to very steep, sandy soils of the Ankeny, Boyer, Boyer, dark surface variant, Casco, Delton, Gotham, Mecan, Metea, Moundville, Oshtemo, Plainfield, Seward, Sisson, and Wyocena series; Alluvial land; and Steep sandy land.	Moderate where slope is 0 to 6 percent; severe where slope is 6 to 12 percent; very severe where slope is more than 12 percent: subject to soil blowing and water erosion; extensive leveling exposes the sandy substratum.	Moderate: low available water capacity; subject to soil blowing and water erosion.
6. Well drained and moderately well drained, deep, nearly level to steep, loamy soils of the Briggsville and Montello series.	Moderate where slope is 0 to 6 percent; severe where slope is more than 6 percent: subject to erosion; moderately slow and slow permeability contributes to temporary ponding.	Slight where slope is 0 to 6 percent; moderate where slope is 6 to 12 percent; severe where slope is more than 12 percent: subject to erosion.

ing trails that are used as they occur in nature with little or no movement of soil. The paths and trails should be relatively dry during the season, should be relatively free of dust, and should have good trafficability. Slope is important for its effect on soil erodibility and the gradient of the paths. Stones and rocks in small numbers are not a serious problem.

A shallow water table and ponding limit the use of poorly drained soils for paths and trails to the drier periods. Flooding during the season of use is very detrimental. The sandy loams and loams generally have good trafficability and are relatively free of dust. Silty soils are slippery when wet and dusty when dry. Clayey soils remain wet for long periods after rains. Organic soils are not suitable for paths and trails.

Golf course fairways are on undisturbed soils. Most greens are constructed from fill materials. In general, the soils for fairways should be relatively dry during the season of use, should have good trafficability, and should be capable of supporting a thick turf without special management. Wetness is important because poorly and very poorly drained soils are generally subject to ponding and are wet for long periods after rains. Frequent flooding during the period of use is very unfavorable, but occasional flooding during this period can be tolerated.

The principal features that determine soil limitations are depth to water table, flood hazard, trafficability, available water capacity, permeability, erosion hazard, and stoniness or rockiness.

Camp areas refers to areas suitable as sites for tents and small camp trailers and the activities that generally center around them. The area of use should be relatively dry and have a relatively low slope gradient, good trafficability, and very few stones and rocks.

Ponding of water on the soil surface has a very unfavorable effect on use of soils for camp areas. Poorly drained and very poorly drained soils are generally subject to frequent ponding. Flooding during any part of the use season is very deterimental. Soil permeability affects use of soils for campsites by limiting the movement of water from the surface into and through the soil. Nearly level soils are the most desirable for campsites. A slope of more than 12 percent is a severe limitation. Trafficability and dust are determined mainly by texture of the surface soil. Sandy loam and loam soils are the most favorable. Excessive rockiness and stoniness are not desirable.

of soils used for recreational facilities

Paths and trails	Golf course fairways	Camp areas
Very severe: high water table; low trafficability; difficult to maintain.	Severe limitations except very severe for Marsh: high water table; turf easily damaged; low trafficability.	Very severe: sites remain wet and soft; poor trafficability.
Slight	Slight where slope is 0 to 6 percent; moderate where slope is 12 to 20 percent; very severe where slope is 20 to 30 percent: unprotected areas are susceptible to erosion.	Moderate where slope is 0 to 6 percent; severe where slope is 6 to 12 percent; very severe where slope is more than 12 percent: surface remains wet and soft after rains; compacts easily.
Severe: high water table; wet for long periods; muddy and slippery when wet; periodic flooding; difficult to maintain.	Severe: high water table; low trafficability; turf easily damaged when wet.	Severe: sites are wet and soft for long periods; poor trafficability when wet; compacts easily; periodic flooding.
Moderate: seasonal high water table; trails and paths are wet and slippery after rainfall and during periods when water table is high.	Moderate: seasonal high water table; turf easily damaged when wet; wet for short periods; muddy and slippery when wet; slopes erodible.	Moderate: sites remain wet and soft for long periods; compacts easily.
Moderate: subject to soil blowing and water erosion; poor stability on slopes; difficult to maintain.	Severe: subject to soil blowing and water erosion; low available water capacity; difficult to maintain good turf.	Moderate: subject to soil blowing and water erosion; low available water capacity; difficult to maintain vegetative cover.
Moderate where slope is 0 to 12 percent; severe where slope is more than 12 percent: muddy and slippery when wet; subject to erosion.	Moderate where slope is 0 to 12 percent; severe where slope is more than 12 percent: erodible on slopes; slippery for short periods after rain.	Moderate where slope is 0 to 6 percent; severe where slope is 6 to 12 percent; very severe where slope is more than 12 percent: surface remains wet and soft for short periods after rain.

Use of the Soils for Wildlife

The wildlife population of any area depends upon the availability of food, cover, and water in a suitable combination. Many kinds of wildlife are common in Marquette County, and their numbers can be significantly increased by proper management of the soils. Table 4 gives the kinds of habitat needed by the principal kinds of wildlife in the county and also rates the importance of the habitat elements to specified kinds of habitat.

The soils of Wisconsin have been placed into eight wildlife groups, and seven of these groups occur in Marquette County. Groups 5 and 6 are considered to be particularly important for wildlife, because they include the valuable wetlands upon which so many species depend. An estimated 10,000 acres in group 5 and 42,000 acres in group 6 are not used for crops or pasture, and these 52,000 acres make up the wetlands of Marquette County. Group 3 soils are dominant throughout the county. They are well suited to produce the vegetative part of wildlife habitat, but they lack the necessary water. Table 5 groups the soils of the county and rates suitability for wildlife of specified habitat elements.

In evaluating the soils for wildlife, no consideration was given to the size, shape, or location of soil bodies, nor to the pattern they form with other soils on the landscape. These factors must be considered if a particular site consisting of two or more kinds of soil is being evaluated. Because of their mobility, wildlife species make use of suitable habitat on a variety of soils within the home range of each given species.

TABLE 4.—*Importance of habitat*

Wildlife species	Grain and seed crops	Grass and legumes
Migratory waterfowl:		
Ducks	Important	Unimportant harvested, important unharvested
Geese	Very important	Very important harvested, unimportant unharvested.
Upland game birds:		
Hungarian partridge	Very important	Important harvested, very important unharvested.
Pheasant	Very important	Not applicable harvested, critical unharvested.
Ruffed grouse	Unimportant	Unimportant harvested, some value unharvested
Woodcock	Not applicable	Unimportant harvested, important unharvested
Small game:		
Rabbits, cottontail	Important harvested, very important unharvested.	Important harvested, critical unharvested
Raccoon	Important harvested, very important unharvested.	Not applicable harvested, unimportant unharvested.
Squirrels, fox and gray	Important harvested, very important unharvested.	Not applicable harvested, unimportant unharvested.
Large game:		
Deer	Important harvested, very important unharvested.	Important
Furbearers:		
Beaver	Not applicable	Not applicable
Fox, red [1]	Some value harvested, important unharvested	Some value harvested, important unharvested
Mink [1]	Not applicable	Not applicable
Muskrat	Unimportant	Not applicable

Carnivorous species are not strictly dependent on elements listed.

For interpretative purposes, the habitat is divided into elements as follows:

Grain and seed crops are seed-producing annuals that are used for food and cover by wildlife. Among these are corn, oats, sorghum, wheat, barley, rye, and soybeans. Ratings for wet soils are given for both drained and undrained areas. Rating criteria applicable only to wildlife are used. Total crop yield is of little significance. Important limitations that affect the ratings are soil wetness, flooding hazard, slope, erosion hazard, low fertility, and droughtiness. Generally, nearly level soils that have a good water content and moderate to high fertility are well suited.

Grass and legumes are those used by wildlife for food and cover. Among the grasses are bluegrass, bromegrass, timothy, and fescue. Some of the legumes are alfalfa, birdsfoot trefoil, red clover, sweetclover, and vetch. Ratings are given for both drained and undrained soils. Total yield is of little significance. Limitations that affect the rating are wetness, flood hazard, droughtiness, unsuitability for a wide variety of species, and relief.

Wild herbaceous upland plants are native or introduced grasses, legumes, and forbs that provide food and cover for upland wildlife. Some of the important plants in this group are bluegrass, prairie grasses, roundhead lespedeza, beggarticks, aster, and goldenrod. The best soils are those suitable for establishment and vigorous growth of a wide variety of species. The principal criteria for rating soils in this habitat element are natural drainage, droughtiness, flood hazard, suitability for a wide variety of species, fertility, and relief.

elements for wildlife species

Wild herbaceous upland plants	Woody plants		Wetland food and cover plants	Shallow and deep water developments
	Hardwood trees and shrubs	Coniferous trees		
Important	Unimportant	Not applicable	Critical	Shallow developments critical, deep developments very important.
Not applicable	Not applicable	Not applicable	Some value	Shallow developments important.
Very important	Unimportant	Not applicable	Unimportant	Not applicable.
Critical	Very important	Unimportant	Critical	Shallow developments important.
Some value	Critical	Important	Not applicable	Not applicable.
Important	Very important	Some value	Important	Not applicable.
Critical	Shrubs critical, hardwood trees important.	Unimportant	Some value	Shallow developments important.
Unimportant	Shrubs some value, hardwood trees very important.	Not applicable	Unimportant	Shallow developments critical.
Unimportant	Shrubs some value, hardwood trees critical.	Unimportant	Not applicable	Not applicable.
Very important	Very important	Very important	Important	Shallow developments important.
Not applicable	Shrubs very important, hardwood trees critical.	Not applicable	Very important	Shallow developments important, deep developments critical.
Important	Shrubs important, hardwood trees some value.	Unimportant	Important	Shallow developments important.
Not applicable	Shrubs some value, hardwood trees unimportant.	Unimportant	Important	Critical.
Not applicable	Unimportant	Not applicable	Very important	Critical.

TABLE 5.—*Suitability of*

[See the "Guide to Mapping Units" for a complete

Wildlife group	Grain and seed crops	Grass and legumes
Wildlife group 1. Boyer, Delton, Fox, Gotham, Lapeer, Mecan, Metea, Oshtemo, Pardeeville, Seward, Sisson, and Wyocena soils that are well drained and moderately well drained, loamy throughout, and not subject to flooding.	Good where slope is 0 to 6 percent, fair where slope is 6 to 12 percent, very poor where slope is more than 20 percent.	Good where slope is 0 to 6 percent, fair where slope is 6 to 12 percent, very poor where slope is more than 20 percent.
Wildlife group 2. Briggsville and Montello soils that are well drained and moderately well drained and have clayey subsoil.	Good where slope is 0 to 6 percent, fair where slope is 6 to 12 percent, very poor where slope is more than 12 percent.	Good where slope is 0 to 12 percent, fair where slope is 12 to 20 percent, very poor where slope is more than 20 percent.
Wildlife group 3. Boyer, Casco, Gotham, Mecan, Metea, Moundville, Oshtemo, Plainfield, and Wyocena soils and Steep sandy land that are well drained and excessively drained or that have a shallow rooting zone.	Fair where slope is 0 to 6 percent, poor on steeper soils: slightly droughty; hazard of water erosion.	Good where slopes are 0 to 12 percent, fair where slopes are 12 to 20 percent, poor on steeper soils: slightly droughty.
Wildlife group 4. Ankeny, Boyer, dark surface variant, and Lorenzo soils that are well drained to moderately well drained, have a thick, dark surface layer, and are loamy throughout.	Poor where slopes are 0 to 6 percent, very poor on steeper soils: droughty; hazard of soil blowing.	Fair: droughty; some species not suited.
Wildlife group 5a. Mosel, Mundelein, Tedrow, and Yahara soils that are somewhat poorly drained.	Good where drained, fair where not drained: seasonally wet.	Good where drained, fair where not drained: some species not suited.
Wildlife group 5b. Colwood, Granby, Keowns, and Poygan soils, Alluvial land, wet, and Marsh that are poorly drained.	Good where drained, very poor where not drained.	Fair where drained, poor where not drained: wet; few species suited.
Wildlife group 6. Adrian; Adrian, stratified subsoil variant; Houghton; Houghton, dark surface variant; Palms; and Rollin organic soils.	Fair where drained, very poor where not drained: wet.	Fair where drained, very poor where not drained: wet; few species suited.
Wildlife group 7. Alluvial land that is subject to flooding.	Good: water erosion hazard; flooding hazard.	Good

habitat elements for wildlife groups

listing of the mapping units in each wildlife group]

Wild herbaceous upland plants	Woody plants		Wetland food and cover plants	Shallow and deep water developments
	Hardwood trees and shrubs	Coniferous trees		
Good	Good where slope is 0 to 20 percent, fair where slope is more than 20 percent.	Good where slope is 0 to 20 percent, fair where slope is more than 20 percent.	Poor where slope is 0 to 2 percent, very poor where slope is more than 2 percent: few species suited.	Poor: soils have slopes up to 30 percent; substratum mostly moderately to rapidly permeable.
Good where slope is 0 to 20 percent, fair where slope is more than 20 percent.	Good where slope is 0 to 20 percent, fair where slope is more than 20 percent.	Good where slope is 0 to 20 percent, fair where slope is more than 20 percent.	Poor where slope is 0 to 2 percent, very poor where slope is more than 2 percent: few species suited.	Poor: soils have slopes up to 20 percent; substratum mostly moderately to slowly permeable.
Good where slopes are 0 to 20 percent, fair on steeper slopes.	Good where slopes are 0 to 20 percent, fair on steeper slopes.	Good where slopes are 0 to 20 percent, fair on steeper slopes.	Poor on slopes of 0 to 2 percent, very poor on steeper soils: few species suited.	Very poor: moderately permeable subsoil; shallow to very porous substratum.
Fair: droughty; some species not suited.	Fair: droughty; some species not suited.	Fair: droughty; some species not suited.	Very poor: droughty	Very poor: loose, sandy soils; rapid permeability.
Fair: seasonally wet; some species not suited.	Fair: seasonally wet; some species not suited; grass competition.	Fair: seasonally wet; some species not suited; grass competition.	Fair where slopes are 0 to 2 percent, poor where slopes are steeper; some species not suited.	Good: seasonally wet; slowly permeable substratum for about half the soils in group; other soils are up to rapidly permeable.
Poor: wet; few species suited; grass competition.	Poor: wet; few species suited; grass competition.	Poor: wet; few species suited; grass competition.	Good: wet	Good: wet; slow or very slowly permeable substratum for about 45 percent of the soils, others are up to rapidly permeable.
Very poor: wet; few species suited.	Poor: wet, few species not suited.	Fair: wet; some species not suited.	Good where slopes are 0 to 2 percent, fair on steeper slopes: wet.	Good: wet; organic deposits to depth of 50 inches or more.
Good	Fair: flooding hazard	Fair: flooding hazard; some species not suited.	Poor: few species suited	Poor: variable permeability; flooding hazard.

Woody plants are shrubs, hardwood trees, and coniferous trees. Shrubs are low-growing woody plants that furnish fruit, seeds, browse, and cover for wildlife. Conifers less than 8 feet tall are in this group. Examples of shrubs are viburnum, dogwood, and hazelnut. Hardwood trees furnish mast, fruit, seeds, dense cover, and browse for wildlife. Examples of hardwood trees are oak, maple, cherry, and nut trees. Coniferous shrubs and small coniferous trees have about the same value as hardwood shrubs and are included in this column. Soils that are suitable show vigorous growth and dependable production from a wide variety of species. Generally some retardation of growth to delay canopy closure is desirable. Limitations that affect soil ratings are wetness, flood hazard, droughtiness, grass competition, unsuitability for a wide variety of species, and relief.

Coniferous trees more than 8 feet tall furnish seeds, fruit, browse, and cover for wildlife. Some of these trees are pines, firs, spruce, tamarack, and cedar. Soils that are suitable for a variety of species and provide for good growth are desirable. Some retardation of growth to delay canopy closure is desirable in most places. Criteria for ratings in this column are soil wetness, flood hazard, droughtiness, grass competition, suitability for a wide variety of species, and relief.

Wetland plants for food and cover include forbs, grasses, sedges, aquatic plants, and woody plants that grow well in wet areas. They furnish fruit, seeds, browse, and cover for wildlife that live in wet areas and on or near open water. Examples are smartweed, canarygrass, sedges, and sagittaria. These plants grow well in (1) seasonally flooded basins and nearly level areas that are covered with water or saturated with water during seasonal wet periods but are usually relatively dry during much of the growing season; (2) fresh meadows that are usually not covered with water during the growing season but are saturated within a few inches of the soil surface; and (3) shrub-swamp areas in which the soil is usually saturated during the growing season and is often covered with as much as 6 inches of water. Soils that are best suited for the growth of a wide variety of climatically adapted species, particularly food-producing plants, are the most desirable for this use. Criteria used for the ratings in this column are wetness, droughtiness, reaction (pH), suitability of a wide variety of species, and relief.

Shallow water areas are less than 5 feet deep. They are natural and dugout areas or water areas formed by a combination of dugouts and low embankments. Common plants are cattails, bulrushes, sedges, and reeds. These are shallow marshes in which the soil is saturated or covered with as much as 6 inches of water during the growing season, and deep marshes that are covered with 6 inches to about 3 feet of water during the growing season.

Deep water areas are more than 5 feet deep. They consist of natural water areas, dugouts, or water areas formed by a combination of dugouts and embankments. Common plants are coontail, water lilies, milfoil, and water weed. The deep water areas consist of ponds, lakes, and open freshwater areas that include shallow ponds and reservoirs or wet areas where water is less than 10 feet deep. Suitable soils are those that have a natural high water table, or have slow permeability, or are nearly level. Many soils that have high water tables but rapid to moderate permeability are well suited to dug-out ponds and level ditching. Low dikes and levees are better suited to less permeable soils. It is especially important that onsite investigations are made in assessing the potential of each proposed pond or shallow water development. The quality and quantity of water may vary considerably between sites.

Engineering Uses of the Soils [3]

This section is useful to those who need information about soils used as structural material or as foundation on which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is in tables 6, 7, 8 and 9. These tables show, respectively, results of engineering laboratory tests on soil samples; several estimated soil properties significant to engineering; interpretations for various engineering uses; and interpretations for various farm uses.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in the tables, and it also can be used to make other useful maps.

[3] ROBERT W. BINTZLER, Assistant State Conservation Engineer, Soil Conservation Service, helped prepare this section.

This information, however, does not eliminate the need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning to soil scientists that is not known to all engineers. The Glossary defines many of these terms commonly used in soil science.

Engineering classification systems

The United States Department of Agriculture system of classifying soil texture is used by agricultural scientists. In this system, the textural class of a soil is based on the properties of sand, silt, and clay in the soil (*3*). In some ways this system of classifying soils is comparable to the systems engineers use in classifying soils. The systems used by engineers are explained briefly in the paragraphs that follow.

Most highway engineers classify soil material in accordance with the AASHO system approved by the American Association of State Highway Officials (*1*).

In this system soil materials are classified in seven principal groups based on the gradation, liquid limit, and plasticity index. The groups are designated as A–1 through A–7. The best soils for subgrades, gravelly soils of high bearing capacity, are classified as A–1; the next best, A–2; and so on to the poorest, A–7, which are clay soils having low strengths when wet. Within each group, the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best materials to 20 for the poorest. The group index number is shown in parentheses after the soil group symbol in table 6.

In the United States soils are identified on the basis of particle size, plasticity, and liquid limit. They are grouped according to their performance as material for engineering construction (*7*). The soil materials are identified as coarse grained, 8 classes; fine grained, 6 classes; and highly organic. The last column of table 6 gives the classification of the tested soils according to the Unified System.

Engineering test data

To help evaluate the soils for engineering purposes, soil samples from major horizons of representative profiles were tested. Table 6 contains the engineering test data for several of the more extensive soils in Marquette County.

The engineering classifications are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods. Percentages of silt and clay determined by the hydrometer method should not be used in naming textural classes for soil classification. The information, however, is useful in determining engineering properties of the soils.

The tests to show liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The *plastic limit* is the moisture content at which the soil material passes from a semisolid to a plastic state. The *liquid limit* is the moisture content at which the material passes from a plastic to a liquid state. The *plasticity index* is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition.

Table 6 also gives optimum moisture and maximum dry density values for most of the tested soils. If soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material will increase until the *optimum moisture content* is reached. After that, the density decreases with increase in moisture content. The highest dry density obtained in the compaction test is termed *maximum dry density*. Moisture-density data are important in earthwork, for, as a general rule, highest stability is obtained if the soil is compacted to maximum dry density when at optimum moisture content.

Soil properties significant in engineering

Classification of the soils and their measured and estimated physical and chemical properties are given in table 7. The information is based on test data in table 6 and tests on similar soils in other counties. Where no tests were available, estimates were made by comparison with similar soils that have been tested and by making observations and determinations in the field.

The estimates in table 7 are for soils as they occur in their natural state and not for disturbed areas that have been altered by cut and fill operations. The soil names are listed alphabetically. Other information about the properties of the soils can be obtained by referring to the section "Descriptions of the Soils." Depth to bedrock is not given because, for the soils of this county, bedrock is generally well beyond depths to which the soils were investigated.

Under "Classification," the respective USDA, Unified, and AASHO classifications are given. The estimated percentages of material passing through the various sieves for each of the major soil horizons have been rounded off to the nearest 5 percent. The range of values is generally ±5 percent of the values given.

In the column showing permeability, the rate at which water moves through a saturated soil horizon is estimated. The ratings are given in inches per hour. Texture, structure, and consistence of the soil are the principal factors that affect soil permeability. The permeability rate of a soil is generally determined by the least permeable layer in the soil.

The estimated available water capacity in inches per inch of soil is given for the major soil horizons. Available water capacity refers to the amount of water that can be stored in the soil for plant use.

TABLE 6.—*Engineering*

[Test performed by State Highway Commission of Wisconsin under a cooperative agreement with the U.S. Dept. of Commerce, Bureau of moisture-density and liquid limit columns

Soil name and location	Soil material	Depth from surface	Moisture-density data [1]	
			Maximum dry density	Optimum moisture
		Inches	*Pound per cubic foot*	*Percent*
Boyer fine sandy loam:				
SW¼NE¼ sec. 9, T. 17 N., R. 9 E. (B horizon more gravelly than modal).	Loam over sandy outwash and some gravel.	5–11	----------	----------
		36–60	----------	----------
NW¼SW¼ sec. 35, T. 16 N., R. 10 E. (B horizon slightly heavier than modal).	Loam over sandy outwash and some gravel.	8–20	----------	----------
		28–60	----------	----------
SW¼SW¼ sec. 16, T. 16 N., R. 10 E. (Modal)	Loam over sandy outwash and some gravel.	9–16	129. 1	9. 2
		32–60	106. 3	12. 6
Briggsville loam:				
SW¼NW¼ sec. 27, T. 15 N., R. 8 E. (Modal)	Less than 18 inches of loam over lacustrine silt.	15–28	99. 7	20. 8
		44–60	105. 3	19. 0
SE¼NE¼ sec. 16, T. 16 N., R. 8 E. (More sandy than modal).	Less than 18 inches of loam over lacustrine silt.	15–26	----------	----------
		36–60	----------	----------
SE¼SE¼ sec. 28, T. 15 N., R. 8 E. (More sandy than modal).	Less than 18 inches of loam over lacustrine silt.	15–30	----------	----------
		48–60	----------	----------
Casco fine sandy loam:				
NE¼SW¼ sec. 3, T. 15 N., R. 10 E. (Modal)	Loams over outwash sand and gravel	8–16	112. 4	16. 1
		18–60	136. 5	8. 2
SW¼SW¼ sec. 27, T. 15 N., R. 10 E. (B horizon more sandy than modal).	Loams over outwash sand and gravel.	6–16	----------	----------
		19–60	----------	----------
SW¼SW¼ sec. 3, T. 14 N., R. 10 E. (Liquid limit)	Loams over outwash sand and gravel.	6–13	----------	----------
		15–60	----------	100
Gotham loamy fine sand:				
SE¼NE¼, sec. 12, T. 16 N., R. 9 E. (B horizon more sandy than modal).	Loamy sand over sandy outwash.	5–22	119. 9	9. 4
		36–60	110. 2	12. 3
NE¼SW¼ sec. 11, T. 14 N., R. 10 E. (B horizon more silty than modal).	Loamy sand over sandy outwash.	8–24	----------	----------
		34–60	----------	----------
NE¼SE¼ sec. 23, T. 17 N., R. 8 E. (Modal)	Loamy sand over sandy outwash.	9–21	----------	----------
		34–60	----------	----------
Lapeer fine sandy loam:				
NE¼SE¼ sec. 33, T. 14 N., R. 9 E. (B horizon less clayey than modal).	Loamy soil over sandy loam till.	17–26	----------	----------
		28–60	----------	100
SE¼SE¼ sec. 26, T. 14 N., R. 10 E. (B horlzon less silty than modal).	Loamy soil over sandy loam till.	16–25	118. 6	12. 5
		27–60	132. 4	7. 0
NW¼NE¼ sec. 36, T. 14 N., R. 10 E. (Modal)	Loamy soil over sandy loam tlll.	13–28	----------	----------
		36–60	----------	----------
Mecan loamy fine sand:				
SE¼SE¼ sec. 24, T. 17 N., R. 9 E. (B horizon more sandy than modal).	Sandy loam to loamy till.	16–24	127	9
		24–48	124	8
		48–60	125	8
SE¼SE¼ sec. 24, T. 17 N., R. 9 E. (Modal)	Sandy loam to loamy till.	15–26	----------	----------
		26–42	----------	----------
		42–60	----------	----------
SE¼SW¼ sec. 19, T. 17 N., R. 10 E. (Profile less sandy than modal).	Sandy loam to loamy till.	18–23	----------	----------
		23–32	----------	----------
		40–60	----------	----------

See footnotes at end of table.

test data

Public Roads, in accordance with standard procedures of the American Association of State Highway officials (AASHO). Dashes in the indicate that no determination was made]

Mechanical analysis [2]										Liquid limit	Plasticity index	Classification	
Percentage passing sieve—						Percentage smaller than—							
3 inches	¾ inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHO	Unified [3]
										Percent			
100	96	83	72	40	10	10	9	7	6	----------	(4)	A-1-b(0)	SW-SM
100	70	34	26	15	2	2	1	1	1	----------	(4)	A-1-a(0)	GW
100	96	87	83	63	22	21	17	12	9	20	4. 3	A-2-4(0)	SM
100	98	97	96	60	2	2	1	1	0	----------	(4)	A-3(0)	SP
100	93	84	80	61	16	16	13	10	8	----------	(4)	A-2-4(0)	SM
---	---	---	100	81	2	2	2	1	1	----------	(4)	A-3(0)	SP
---	---	---	---	100	97	95	82	56	47	61	37	A-7-6(20)	CH
---	---	---	---	100	99	97	81	53	35	41	22	A-7-6(13)	CL
---	---	---	100	98	88	86	79	61	48	58	36	A-7-6(20)	CH
---	---	---	100	99	94	93	83	58	41	46	25	A-7-6(19)	CL
---	---	---	100	96	82	80	72	48	37	44	24	A-7-6(15)	CL
---	---	---	---	100	96	93	76	46	28	35	17	A-6(11)	CL
100	96	87	83	69	37	35	31	26	23	41	24	A-7-6(3)	SC
100	60	37	31	18	5	4	2	1	1	----------	(4)	A-1-a(0)	GP-GM
100	96	88	84	44	21	20	17	12	10	32	17	A-2-6(0)	SC
100	72	43	37	12	3	3	2	1	1	----------	(4)	A-1-a(0)	GP
---	---	---	100	82	40	39	33	23	18	30	15	A-6(2)	SC
73	44	28	25	18	3	2	1	1	1	----------	(4)	A-1-a(0)	GP
---	---	---	100	84	12	11	9	6	5	----------	(4)	A-2-4(0)	SP-SM
---	---	---	100	82	5	4	3	2	2	----------	(4)	A-3(0)	SP-SM
---	---	---	100	93	18	16	12	6	4	----------	(4)	A-2-4(0)	SM
---	---	---	100	96	4	3	2	2	1	----------	(4)	A-3(0)	SP
---	---	---	100	97	25	20	11	7	5	----------	(4)	A-2-4(0)	SM
---	---	---	100	74	2	2	2	1	1	----------	(4)	A-3(0)	SP
---	100	96	93	70	20	18	16	13	11	18	2	A-2-4(0)	SM
92	81	73	70	60	20	16	9	5	4	----------	(4)	A-2-4(0)	SM
100	93	90	89	82	33	29	24	19	17	27	12	A-2-6(0)	SC
100	79	69	65	57	18	13	7	4	3	----------	(4)	A-2-4(0)	SM
---	---	---	100	92	40	36	27	20	17	22	8	A-4(1)	SC
100	95	89	86	79	32	26	14	8	6	----------	(4)	A-2-4(0)	SM
100	98	96	95	83	17	16	15	12	11	----------	(4)	A-2-4(0)	SM
100	96	92	90	74	11	11	10	8	6	----------	(4)	A-2-4(0)	SP
100	96	88	85	70	10	9	8	6	5	----------	(4)	A-3(0)	SP
---	---	---	100	86	29	22	17	15	13	----------	(4)	A-2-4(0)	SM
---	---	---	100	85	26	19	14	12	10	----------	(4)	A-2-4(0)	SM
---	---	---	100	87	20	13	9	6	5	----------	(4)	A-2-4(0)	SM
---	---	---	100	90	37	30	20	16	16	20	4	A-2-4(0)	SM
---	---	---	100	88	31	24	16	11	9	----------	(4)	A-2-4(0)	SM
---	---	100	93	83	33	24	14	8	6	----------	(4)	A-2-4(0)	SM

TABLE 6.—*Engineering*

Soil name and location	Soil material	Depth from surface	Moisture-density data [1]	
			Maximum dry density	Optimum moisture
		Inches	*Pound per cubic foot*	*Percent*
Sisson fine sandy loam:				
SW¼NW¼ sec. 19, T. 15 N., R. 8 E. (Modal)	Lacustrine silt and fine sand.	10–18 30–60	110. 4 113. 0	16. 5 15. 7
SW¼SW¼ sec. 23, T. 17 N., R. 8 E. (Less clayey substratum than modal).	Lacustrine silt and fine sand.	16–28 36–60	--- ---	--- ---
NE¼SE¼ sec. 20, T. 15 N., R. 8 E. (More silty profile than modal).	Lacustrine silt and fine sand.	16–36 39–60	--- ---	--- ---

[1] Based on AASHO Designation T 99–57, Method C (*1*).

[2] Mechanical analysis according to AASHO Designation: T 88–57. Results from this procedure frequently differ somewhat from the results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method

TABLE 7.—*Estimated soil*

[An asterisk in the first column indicates that at least one mapping unit in the series is made up of two or more kinds of soil that may are in the first column. The

Soil series and map symbols	Depth to water table or saturated zone	Depth from surface	Classification	
			USDA texture	Unified
	Feet	*Inches*		
Adrian:				
Ac	0–1	0–36 36–60	Mucky peat and muck Sand	Pt SP
Ad	0–1	0–28 28–60	Peat and mucky peat Sand	Pt SP
Adrian, stratified subsoil variant:				
Ae	0–1	0–36 36–60	Muck, peat, and mucky peat Thin layers of loam, fine sandy loam, and loamy fine sand.	Pt ML
Ak	0–1	0–28 28–60	Peat and mucky peat Thin layers of loam, fine sandy loam, and loamy fine sand.	Pt ML
Alluvial land: Am, An. Properties are too variable to classify.				
Ankeny: Ao	>5	0–45 45–60	Fine sandy loam Loamy fine sand	SM SM
*Boyer: BmB, BmC2, BmD2, BmE2, BnB, BnC2, BnD2, BrB, BrC2. For the Oshtemo part of BrB and BrC2, see Oshtemo series.	>5	0–8 8–28 28–60	Loamy fine sand Sandy loam Sand and gravel	SM SM SP

See footnotes at end of table.

test data—Continued

Mechanical analysis [2]										Liquid limit	Plasticity index	Classification	
Percentage passing sieve—						Percentage smaller than—							
3 inches	¾ inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHO	Unified [3]
										Percent			
			100	99	80	66	45	32	27	39	21	A-6(13)	CL
				100	82	63	35	22	17	25	5	A-4(1)	CL
			100	98	73	65	48	32	27	34	16	A-6(10)	CL
			100	92	38	29	17	9	6		(4)	A-4(1)	SM
				100	98	96	69	31	23	38	15	A-6(10)	CL
				100	98	97	62	21	14	28	5	A-4(8)	ML

and the material coarser than 2 millimeters in diameter is excluded from calculations of the grain-size fractions. The mechanical analysis used in the table are not suitable for use in naming textural classes for soils.

[3] SCS and BPR have agreed that all soils have plasticity indexes within 2 points of the A-line are to be given borderline classifications. SP–SM is an example of a borderline classification obtained by this use.

[4] Nonplastic.

properties significant in engineering

have different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that symbol > means more than]

Classification—Con.	Percentage passing sieve [1]—			Permeability	Available water capacity	Reaction	Shrink-swell potential
AASHO	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 200 (0.074 mm)				
				Inches per hour	*Inches per inch of soil*	*pH value*	
				2. 0–6. 3	0. 30–0. 40	5. 6–6. 5	High.[2]
A-3		100	4	6. 3–20. 0	0. 04–0. 06	5. 6–6. 5	Low.
				2. 0–6. 3	0. 30–0. 40	5. 6–6. 5	High.[2]
A-3		100	4	6. 3–20. 0	0. 04–0. 06	6. 6–7. 3	Low.
				2. 0–6. 3	0. 30–0. 40	6. 6–7. 8	High.[2]
A-4		100	80	0. 63–2. 0	0. 16–0. 20	6. 6–7. 8	Low to moderate.
				2. 0–6. 3	0. 30–0. 40	6. 6–7. 8	High.[2]
A-4		100	80	0. 63–2. 0	0. 16–0. 20	6. 6–7. 8	Low to moderate.
A-2	100	90	30	2. 0–6. 3	0. 10–0. 12	5. 6–6. 5	Low.
A-2	95	90	20	6. 3–20. 0	0. 08–0. 10	5. 6–6. 5	Low.
A-2	100	95	15	6. 3–20. 0	0. 08–0. 12	7. 9–8. 4	Low.
A-2	85	80	15	2. 0–6. 3	0. 10–0. 12	5. 6–6. 5	Low.
A-3	95	90	4	>20	0. 02–0. 04	7. 4–8. 4	Low.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to water table or saturated zone	Depth from surface	Classification	
			USDA texture	Unified
	Feet	*Inches*		
Boyer, dark surface variant: BoA, BoB, BoC2	>5	0–12	Fine sandy loam and sandy loam.	SM
		12–33	Loamy sand	SM
		33–60	Sand and gravel	SP
Briggsville: BsA, BsB, BsC2, BsD2, BvA, BvB	>5	0–11	Silt loam	ML
		11–32	Silty clay loam and silty clay	CL or CH
		32–60	Heavy silty clay loam	CL
Casco: CaB, CaC2, CaD2, CaE2	>5	0–7	Fine sandy loam	SM
		7–19	Sandy clay loam and light clay loam.	SC
		19–60	Sand and gravel	GP
Colwood: Co	0–1	0–8	Loam and fine sandy loam	SM
		8–24	Clay loam and silty clay loam.	ML
		24–60	Loamy very fine sand	ML
Delton: DeB, DeC2, DfA, DfB, DfC2	>5	0–37	Loamy fine sand	SM
		37–60	Silty clay	CL
Fox: FmB, FmC2, FoB, FoC2	>5	0–17	Loam	ML
		17–34	Sandy clay loam	SC
		34–60	Sand and gravel	SP
Gotham:				
GlA, GlB, GlC, GlD, GnA, GnB	>5	0–26	Loamy fine sand, loamy sand, and fine sandy loam.	SM
		26–60	Medium and coarse sand	SP
GmA, GmB, GmC2, GmD2, GoA	>5	0–26	Loamy fine sand	SM
		26–36	Sand	SP
		36–60	Loam	ML
Granby:				
Gr, Gs	0–1	0–8	Fine sandy loam	SM
		8–17	Loamy fine sand	SM
		17–60	Fine sand	SP
Gt	0–1	0–8	Fine sandy loam	SM
		8–17	Loamy fine sand	SM
		17–36	Sand	SP
		36–60	Loam	WL
Houghton: Hm	0–1	0–60	Mucky peat	Pt
Houghton, acid variant. Hp	0–1	0–60	Mucky peat	Pt
Keowns: Ke	0–1	0–24	Fine sandy loam	SM
		24–60	Silt and fine sand	SM
*Lapeer: LpB, LpC2, LpD2, LpE2. For Pardeeville part of LpB, LpC2, LpD2, LpE2, see the Pardeeville series.	>5	0–13	Fine sandy loam	SM
		13–35	Sandy clay loams and sandy loam.	SC
		35–60	Gravelly sandy loam	SM
Lorenzo: LrA, LrB	>5	0–11	Loam	ML
Marsh: Ma. Properties are too variable to classify.		11–15	Sandy clay loam	SC
		15–60	Cobbly and gravelly sand	SP
Mecan: McD2, McE2, MeB, MeC2	>5	0–12	Loamy fine sand	SM
		12–47	Sandy loam	SM
		47–60	Loamy sand	SM

See footnotes at end of table.

significant in engineering—Continued

Classification—Con.	Percentage passing sieve [1]—			Permeability	Available water capacity	Reaction	Shrink-swell potential
AASHO	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 200 (0.074 mm)				
				Inches per hour	*Inches per inch of soil*	*pH value*	
A-2	100	90	30	2. 0–6. 3	0. 10–0. 12	5. 6–6. 5	Low.
A-2	85	80	15	6. 3–20. 0	0. 06–0. 08	5. 6–6. 5	Low.
A-3	95	90	4	>20	0. 02–0. 04	7. 4–8. 4	Low.
A-4	----------	100	90	0. 63–2. 0	0. 20–0. 24	5. 6–6. 5	Low.
A-7	----------	100	95	0. 20–0. 63	0. 18–0. 20	5. 1–6. 5	Moderate.
A-7	----------	----------	100	0. 20–0. 63	0. 16–0. 20	5. 4–7. 8	Moderate.
A-2	100	90	30	2. 0–6. 3	0. 12–0. 14	5. 6–6. 5	Low.
A-6	95	80	40	0. 63–2. 0	0. 16–0. 20	5. 6–6. 5	Moderate.
A-1	40	30	4	6. 3–20. 0	0. 02–0. 04	7. 4–8. 4	Very low.
A-2	100	90	65	2. 0–6. 3	0. 16–0. 20	6. 1–6. 5	Low.
A-7-6	95	95	70	0. 63–2. 0	0. 18–0. 20	6. 1–6. 5	Moderate.
A-4	----------	100	60	0. 63–2. 0	0. 12–0. 14	7. 4–8. 4	Low.
A-2-4	100	80	20	2. 0–6. 3	0. 10–0. 12	5. 1–6. 5	Low.
A-7	----------	100	95	0. 06–0. 20	0. 16–0. 18	5. 1–6. 5	Moderate.
A-4	95	85	60	0. 63–2. 0	0. 18–0. 20	6. 1–7. 3	Low.
A-6	----------	100	40	0. 63–2. 0	0. 16–0. 18	5. 6–6. 5	Moderate.
A-1	90	45	4	6. 3–20. 0	0. 02–0. 04	7. 4–8. 4	Low.
A-2	----------	100	25	6. 3–20. 0	0. 08–0. 10	5. 6–6. 5	Low.
A-3	----------	100	4	6. 3–20. 0	0. 04–0. 06	5. 6–7. 3	Low.
A-2	100	95	25	6. 3–20. 0	0. 08–0. 10	5. 6–6. 5	Low.
A-3	----------	100	4	6. 3–20. 0	0. 04–0. 06	5. 6–6. 5	Low.
A-4	95	85	65	0. 63–2. 0	0. 16–0. 18	5. 6–7. 3	Low.
A-2	100	90	30	2. 0–6. 3	0. 12–0. 14	6. 6–7. 3	Low.
A-2	100	95	25	6. 3–20. 0	0. 08–0. 10	6. 6–7. 3	Low.
A-3	100	95	4	6. 3–20. 0	0. 04–0. 06	6. 1–8. 4	Low.
A-2	100	90	30	2. 0–6. 3	0. 12–0. 14	6. 6–7. 3	Low.
A-2	100	95	25	6. 3–20. 0	0. 08–0. 10	6. 6–8. 4	Low.
A-3	100	94	4	6. 3–20. 0	0. 04–0. 06	5. 6–6. 5	Low.
A-4	95	85	65	0. 63–2. 0	0. 16–0. 18	6. 6–8. 4	Low.
----------	----------	----------	----------	2. 0–6. 3	0. 30–0. 40	5. 6–6. 5	High.[2]
----------	----------	----------	----------	2. 0–6. 3	0. 30–0. 40	4. 0–5. 5	High.[2]
A-4	----------	100	40	0. 63–2. 0	0. 12–0. 14	6. 6–7. 8	Low.
A-4	----------	100	40	0. 63–2. 0	0. 12–0. 14	7. 4–8. 4	Low.
A-2	95	90	30	2. 0–6. 3	0. 12–0. 14	5. 6–7. 3	Low.
A-2 or A-4	95	95	36	0. 63–2. 0	0. 16–0. 18	5. 6–6. 5	Moderate.
A-2	80	75	25	0. 63–2. 0	0. 08–0. 10	7. 4–8. 4	Low.
A-4	95	85	60	0. 63–2. 0	0. 20–0. 22	5. 6–6. 5	Low.
A-4	95	95	40	0. 63–2. 0	0. 16–0. 18	5. 6–6. 5	Moderate.
A-1	85	85	4	>20	0. 02–0. 04	5. 6–8. 4	Low.
A-2-4	100	95	20	6. 3–20. 0	0. 08–0. 10	5. 6–6. 5	Low.
A-2	----------	100	30	2. 0–6. 3	0. 10–0. 12	6. 4–7. 3	Low.
A-2	----------	100	20	6. 3–20. 0	0. 04–0. 06	6. 6–8. 4	Low.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to water table or saturated zone	Depth from surface	Classification	
			USDA texture	Unified
	Feet	*Inches*		
Metea:				
MfB, MfC2, MfD, MmB, MmC, MmD2	>5	0–24	Loamy fine sand	SM
		24–43	Sandy clay loam	CL
		43–60	Sandy loam	SM
MoA, MoB, MoC	>5	0–24	Fine sandy loam	SM
		24–43	Clay loam	CL
		43–60	Silt and sand	ML
MlB, MlC2, MnB, MnC2	>5	0–26	Loamy fine sand	SM
		26–44	Clay loam	CL
		44–60	Sand	SP
Montello: MrA, MrB, MsA, MsB	3–5	0–12	Silt loam	ML
		12–60	Silty clay loam	CL
Mosel: MtA, MuA	1–3	0–8	Loam	ML
		8–22	Sandy loam	SM
		22–30	Sandy clay loam	SC
		30–60	Silty clay loam	CL
Moundville: MvA, MwA	>5	0–32	Loamy fine sand	SM
		32–60	Fine sand	SP
Mundelein: MxA, MyA	1–3	0–12	Silt loam	ML
		12–21	Silty clay loam	ML
		21–30	Silt loam	ML
		30–60	Silt loam and very fine sand	ML
Oshtemo: OsA, OsB, OsC2, OsD2, OtA, OtB, OtC2	>5	0–11	Loamy fine sand	SM
		11–34	Sandy loam	SM
		34–42	Loamy sand	SM
		42–60	Sand	SP
Palms:				
Pa	0–1	0–36	Disintegrated peat and mucky peat.	Pt
		36–60	Silty clay loam	ML–CL
Pc	0–1	0–25	Disintegrated peat and mucky peat.	Pt
		25–60	Silty clay loam	ML–CL
Pardeeville. Mapped only in complex with Lapeer soils.	>5	0–8	Fine sandy loam	SM
		8–34	Sandy loam	SM
		34–60	Loamy sand	SM
*Plainfield:				
PlA, PlB, PlC, PlD2, PnB, PnC, and PnE	>5	0–8	Loamy fine sand	SM
For Wyocena part of PnB, PnC, and PnE, see Wyocena series.		8–60	Sand	SP–SM
PfC2, PfD2	>5	0–60	Sand	SP
Poygan: Ps, Po	0–1	0–8	Silty clay loam	ML
		8–26	Silty clay	CL or CH
		26–60	Clay	CL or CH
Rollin: Ro	0–1	0–36	Mucky peat	Pt
		36–60	Marl	
Seward: SeA, SeB	3–5	0–3	Fine sandy loam	SM
		3–20	Loamy fine sand	SM
		20–60	Silty clay loam	CL
Sisson: SoA, SoB2, SsA, SsB	>5	0–10	Fine sandy loam	SM
		10–30	Silty clay loam and loam	ML or CL
		30–60	Stratified silt loam, silt, and fine sand.	ML or CL

See footnotes at end of table.

significant in engineering—Continued

Classification—Con.	Percentage passing sieve [1]—			Permeability	Available water capacity	Reaction	Shrink-swell potential
AASHO	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 200 (0.074 mm)				
				Inches per hour	*Inches per inch of soil*	*pH value*	
A–2	100	90	20	2. 0–6. 3	0. 10–0. 12	6. 6–7. 8	Low.
A–4	100	90	51	0. 63–2. 0	0. 16–0. 18	6. 1–7. 8	Moderate.
A–2	80	75	30	0. 63–2. 0	0. 10–0. 12	7. 4–8. 4	Low.
A–2	100	90	30	2. 0–6. 3	0. 12–0. 14	6. 6–7. 8	Low.
A–6	100	90	70	0. 63–2. 0	0. 10–0. 20	6. 1–7. 8	Moderate.
A–4	----------	100	80	0. 63–2. 0	0. 12–0. 14	5. 6–7. 3	Low.
A–2–4	100	95	20	6. 3–20. 0	0. 08–0. 10	6. 6–7. 8	Low.
A–6	100	90	70	0. 63–2. 0	0. 18–0. 20	6. 1–7. 8	Moderate.
A–3	95	95	4	6. 3–2. 0	0. 04–0. 06	6. 6–7. 3	Low.
A–4	----------	100	80	0. 63–2. 0	0. 22–0. 24	6. 6–7. 3	Low.
A–7	----------	100	90	0. 20–0. 63	0. 14–0. 18	6. 1–8. 4	Moderate.
A–4	100	90	55	0. 63–2. 0	0. 18–0. 22	5. 6–6. 5	Low.
A–2	100	90	30	2. 0–6. 3	0. 10–0. 12	6. 1–6. 5	Low.
A–4	95	95	40	0. 63–2. 0	0. 16–0. 18	6. 6–7. 3	Moderate.
A–6	----------	----------	100	0. 20–0. 63	0. 16–0. 18	7. 4–8. 4	Moderate.
A–2	100	95	25	6. 3–20. 0	0. 08–0. 10	5. 1–7. 3	Low.
A–3	----------	100	4	6. 3–20. 0	0. 04–0. 06	5. 7–5. 5	Low.
A–4	----------	100	80	0. 63–2. 0	0. 22–0. 24	7. 4–8. 4	Low.
A–6	----------	100	85	0. 20–0. 63	0. 16–0. 20	6. 6–7. 3	Moderate.
A–4	----------	100	80	0. 63–2. 0	0. 20–0. 22	6. 6–7. 3	Low.
A–4	----------	100	80	0. 63–2. 0	0. 16–0. 18	7. 4–8. 4	Low.
A–2	100	95	15	6. 3–20. 0	0. 08–0. 10	5. 1–7. 3	Low.
A–2	95	90	35	2. 0–6. 3	0. 10–0. 12	5. 6–6. 5	Low.
A–2	100	95	15	6. 3–20. 0	0. 08–0. 10	5. 6–6. 0	Low.
A–3	95	90	4	>20	0. 04–0. 06	7. 4–8. 4	Low.
----------	----------	----------	----------	2. 0–6. 3	0. 30–0. 40	5. 6–6. 5	High.[2]
A–7	----------	----------	100	0. 06–0. 20	0. 16–0. 18	7. 4–8. 4	Moderate.
----------	----------	----------	----------	2. 0–6. 3	0. 30–0. 40	5. 6–6. 5	High.[2]
A–7	----------	----------	100	0. 06–0. 20	0. 16–0. 18	7. 4–8. 4	Moderate.
A–2	100	95	35	0. 63–2. 0	0. 14–0. 18	5. 6–6. 5	Low.
A–2	100	95	25	2. 0–6. 3	0. 10–0. 12	5. 1–6. 0	Low.
A–2	100	90	20	2. 0–6. 3	0. 08–0. 10	6. 1–7. 3	Low.
A–2	100	95	20	6. 3–20. 0	0. 08–0. 10	6. 6–7. 3	Low.
A–3	100	95	10	>20	0. 04–0. 06	5. 1–6. 5	Low.
A–3	95	55	4	>20	0. 06–0. 08	5. 1–6. 5	Low.
A–6	----------	100	95	0. 63–2. 0	0. 20–0. 22	7. 4–7. 8	Moderate.
A–7	----------	100	90	0. 20–0. 63	0. 14–0. 16	7. 4–8. 4	High.
A–7	----------	100	90	0. 06–0. 20	0. 10–0. 12	7. 4–8. 4	High.
----------	----------	----------	----------	2. 0–6. 3	0. 30–0. 40	7. 4–8. 4	High.[2]
----------	----------	----------	----------	----------	----------	8. 4	Moderate.
A–2	100	90	30	2. 0–6. 3	0. 10–0. 12	5. 1–5. 5	Low.
A–2–4	100	80	15	6. 3–20. 0	0. 08–0. 10	6. 1–6. 5	Low.
A–6	----------	100	95	0. 06–0. 20	0. 16–0. 18	7. 4–8. 4	Moderate.
A–2	100	90	30	2. 0–6. 3	0. 10–0. 12	6. 6–7. 3	Low.
A–6	----------	100	80	0. 63–2. 0	0. 16–0. 18	5. 6–6. 5	Moderate.
A–4	----------	100	80	0. 63–2. 0	0. 16–0. 18	7. 4–8. 4	Low.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to water table or saturated zone	Depth from surface	Classification	
			USDA texture	Unified
	Feet	*Inches*		
Steep sandy land: StF. Properties are too variable to classify.				
Tedrow:				
TdA, TfA	1–3	0–3	Fine sandy loam	SM
		3–24	Loamy fine sand	SM
		24–60	Fine sand	SP
TeA, TlA	1–3	0–3	Fine sandy loam	SM
		3–24	Loamy fine sand	SM
		24–42	Fine sand	SP
		42–60	Loam	ML
Wyocena: WoB, WoC, WoD, WoE, WyB, WyC2	>5	0–15	Loamy sand	SM
		15–36	Sandy loam	SM
		36–60	Loamy sand and sand	SM
Yahara: YaA	1–3	0–25	Fine sandy loam	SM
		25–60	Loam stratified with silt and fine sand.	ML

[1] These are average values that are the midpoint of an 8- to 10-point range.

TABLE 8.—*Engineering interpretations*

[An asterisk in the first column indicates that at least one mapping unit in the series is made up of two or more kinds of soil that may that are in

Soil series and map symbols	Suitability as a source of—	
	Topsoil	Sand and gravel
Adrian: Ac, Ad	Poor: erodible; oxidizes rapidly; high water table.	Unsuitable: underlying sand poorly graded; contains some fines.
Adrian, stratified subsoil variant: Ae, Ak	Poor: erodible; oxidizes rapidly; high water table.	Unsuitable: underlying sand variable and contains fines.
Alluvial land:		
Am	Poor: sandy in many places	Unsuitable: very little gravel; wide range of textures.
An	Poor to good: frequently flooded	Unsuitable: very little gravel; wide range of soil textures.
Ankeny: Ao	Surface layer and subsoil fair: medium available water capacity.	Unsuitable: well-graded loamy sand
*Boyer: BmB, BmC2, BmD2, BmE2, BnB, BnC2, BnD2, BrB, BrC2. For ratings of Oshtemo soils in BrB and BrC2 see Oshtemo series.	Surface layer fair, subsoil poor: thin over sand and gravel.	Fair: substratum is poorly graded sand and has some pockets of gravel.

See footnote at end of table.

significant in engineering—Continued

Classification—Con.	Percentage passing sieve [1]—			Permeability	Available water capacity	Reaction	Shrink-swell potential
AASHO	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 200 (0.074 mm)				
				Inches per hour	*Inches per inch of soil*	*pH value*	
A–2	100	90	30	2. 0–6. 3	0. 10–0. 12	6. 1–6. 5	Low.
A–2	100	95	25	6. 3–20. 0	0. 08–0. 10	6. 1–7. 8	Low.
A–3	100	95	4	6. 3–20. 0	0. 04–0. 06	7. 4–7. 8	Low.
A–2	100	90	30	2. 0–6. 3	0. 10–0. 12	6. 1–6. 5	Low.
A–2–4	100	95	25	2. 0–6. 3	0. 08–0. 10	6. 1–7. 8	Low.
A–3	100	95	4	6. 3–20. 0	0. 04–0. 06	5. 6–7. 3	Low.
A–4	100	90	55	0. 63–2. 0	0. 12–0. 14	5. 6–7. 3	Low.
A–2–4	100	95	15	6. 3–20. 0	0. 08–0. 10	6. 1–6. 5	Low.
A–2	95	85	40	2. 0–6. 3	0. 10–0. 12	6. 1–6. 5	Low.
A–2–4	95	95	15	6. 3–20. 0	0. 08–0. 10	5. 6–7. 8	Low.
A–4	----------	100	40	0. 63–2. 0	0. 12–0. 14	6. 1–7. 3	Low.
A–4	----------	100	70	0. 63–2. 0	0. 16–0. 18	6. 1–7. 8	Low.

[2] Does not exert pressure against structures as does mineral soil material.

of soils for town and country planning

have different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series the first column]

Limitations for—			Corrosion potential for conduits	
Transportation systems [1]	Foundations for low buildings [1]	Onsite sewage disposal	Metal	Concrete
Very severe: high water table; very low stability and bearing capacity.	Severe: high water table; very low stability and bearing capacity.	Very severe: high water table.	Very high in organic soil; moderate in sand.	Low.
Very severe: high water table; very low stability and bearing capacity.	Severe: high water table; very low stability and bearing capacity.	Very severe: high water table.	Very high in organic soil; moderate in sand.	Low.
Severe: very low stability and bearing capacity.	Severe: liquefies easily; very high frost hazard; fair shear strength; moderate compressibility.	Very severe: periodic overflow.	Low----------	Low.
Very severe: unstable; very low stability and bearing capacity; frequently flooded.	Very severe: subject to frost heave; fair shear strength; moderate compressibility; frequently flooded.	Very severe: high water table; frequently flooded.	Low----------	Low.
Moderate: subject to occasional flooding.	Moderate: subject to occasional flooding.	Severe: subject to occasional flooding.	Low----------	Low.
Slight----------	Slight----------	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if greater than 12 percent: danger of ground water contamination.	Low----------	Low.

TABLE 8.—*Engineering interpretations of soils*

Soil series and map symbols	Suitability as a source of—	
	Topsoil	Sand and gravel
Boyer, dark surface variant: BoA, BoB, BoC2.	Surface layer fair, subsoil poor: moderately deep over sand and gravel.	Fair: substratum is poorly graded sand and has some pockets of gravel.
Briggsville: BsA, BsB, BsC2, BsD2, BvA, BvB.	Surface layer good; subsoil unsuitable, very firm.	Unsuitable: no sand or gravel
Casco: CaB, CaC2, CaD2, CaE2	Surface layer fair: medium available water capacity; subsoil poor; gravelly in lower part.	Good
Colwood: Co	Surface layer and subsoil fair: unstable on slopes; stratified with sand; high water table.	Unsuitable: no sand or gravel
Delton: DeB, DeC2, DfA, DfB, DfC2	Surface layer fair: low to medium available water capacity; subsoil poor: clayey.	Unsuitable: no sand or gravel
Fox: FmB, FmC2, FoB, FoC2	Surface layer good, subsoil fair: lower part of subsoil gravelly.	Good
Gotham: GlA, GlB, GlC, GlD, GmA, GmB, GmC2, GmD2, GnA, GnB, GoA.	Surface layer poor, subsoil unsuitable: low available water capacity; subject to soil blowing.	Good: contains some fines in places
Granby: Gr, Gs, Gt	Surface layer fair: dark; subsoil unsuitable: blows easily; droughty.	Fair, except Gt is poor: substratum is poorly graded sand; high water table hinders excavation.
Houghton: Hm	Poor: erodible and oxidizes rapidly; high water table.	Unsuitable: no sand and gravel
Houghton, acid variant: Hp	Poor: erodible and oxidizes rapidly; high water table.	Unsuitable: no sand and gravel
Keowns: Ke	Surface layer fair: medium available water capacity; subsoil fair: unstable on slopes; seasonal high water table.	Poor: substratum contains layers of fine sand with silt strata; high water table hinders excavation.
*Lapeer–Pardeeville: LpB, LpC2, LpD2, LpE2. Ratings apply to both Lapeer and Pardeeville soils.	Surface layer fair: droughty; subsoil fair: lower part of subsoil has medium available water capacity.	Poor: substratum contains pockets of well-sorted sand and gravel.
Lorenzo: LrA, LrB	Surface layer good: dark; subsoil fair to poor: gravelly in lower part.	Good

See footnote at end of table.

for town and country planning—Continued

Limitations for—			Corrosion potential for conduits	
Transportation systems [1]	Foundations for low buildings [1]	Onsite sewage disposal	Metal	Concrete
Slight	Slight	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent: danger of ground water contamination.	Low	Low.
Moderate: subsoil and substratum moderately plastic to highly plastic; elastic; moderate shrink-swell potential.	Moderate: moderate shrink-swell potential; high compressibility; poor shear strength.	Severe: moderately slow permeability.	Low	Low.
Slight	Slight	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if greater than 12 percent: danger of ground water contamination.	Low	Low.
Severe: subsoil has moderate shrink-swell potential and low bearing capacity; unstable on slopes; substratum fairly stable where properly compacted.	Severe: fair shear strength; low compressibility; becomes liquid easily; subject to frost heave.	Very severe: high water table.	Very high	Low.
Slight	Slight	Moderate: slow permeability in substratum.	Low	Low.
Slight	Slight	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent: danger of ground water contamination.	Low	Low.
Slight	Slight	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if greater than 12 percent: danger of ground water contamination.	Low	Low.
Severe: high water table; likely to become liquid when wet.	Severe: very low compressibility; good shear strength; if saturated may flow during excavation; high water table.	Very severe: high water table.	Low	Low.
Very severe: high water table; all engineering qualities unfavorable.	Very severe: high water table; all engineering qualities unfavorable.	Very severe: high water table.	Very high	Low.
Very severe: high water table; all engineering qualities unfavorable.	Very severe: high water table; all engineering qualities unfavorable.	Very severe: high water table.	Very high	Very high.
Severe: high water table; subsoil relatively unstable; substratum has moderate shrink-swell potential; low stability.	Severe: high water table; may flow when saturated; fairly low compressibility.	Very severe: high water table.	High	Low.
Slight	Slight	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if greater than 12 percent.	Low to moderate	Low.
Slight	Slight	Slight: danger of ground water contamination.	Low	Low.

TABLE 8.—*Engineering interpretations of soils*

Soil series and map symbols	Suitability as a source of—	
	Topsoil	Sand and gravel
Marsh: Ma	Unsuitable: extremely variable	Unsuitable: no sand and gravel
Mecan: McD2, McE2, MeB, MeC2	Surface layer fair: low available water capacity; erodible; subsoil poor: low available water capacity; subject to soil blowing.	Poor: mixture of sand and fines
Metea: MfB, MfC2, MfD, MmB, MmC, MmD2	Surface layer and subsoil fair: medium available water capacity.	Poor: substratum contains pockets of sand and gravel.
MlB, MlC2, MnB, MnC2	Surface layer and subsoil fair: medium available water capacity.	Fair to good: substratum has poorly graded sand and contains some fines.
MoA, MoB, MoC	Surface layer and subsoil fair: medium available water capacity.	Unsuitable: substratum contains excessive fines.
Montello: MrA, MrB, MsA, MsB	Surface layer good, subsoil unsuitable: very firm.	Unsuitable: no sand and gravel
Mosel: MtA, MuA	Surface layer good; subsoil fair in upper part, poor in lower part: lower part of subsoil and substratum are clayey.	Unsuitable: no sand and gravel
Moundville: MvA, MwA	Surface layer fair, subsoil unsuitable: low available water capacity; subject to soil blowing.	Good for sand; very little gravel
Mundelein: MxA, MyA	Surface layer good, subsoil fair: unstable slopes.	Poor: substratum contains poorly graded fine sand and silt layers.
Oshtemo: OsA, OsB, OsC2, OsD2, OtA, OtB, OtC2.	Surface layer unsuitable: low available water capacity; erodible; subsoil poor: low available water capacity.	Fair: substratum has poorly graded sand and a few pockets of gravel.
Palms: Pa, Pc	Poor: erodible; oxidizes rapidly; high water table.	Unsuitable: no sand and gravel

See footnote at end of table.

for town and country planning—Continued

Limitations for—			Corrosion potential for conduits	
Transportation systems [1]	Foundations for low buildings [1]	Onsite sewage disposal	Metal	Concrete
Very severe: flooded much of the time.	Very severe: flooded much of the time.	Very severe: high water table.	High	Low if pH is more than 5.5; very high if less than 5.5.
Slight	Slight	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if greater than 12 percent: danger of ground water contamination.	Low	Low.
Slight	Slight	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if greater than 12 percent.	Low to moderate	Low.
Slight	Slight	Slight if slope is 2 to 6 percent, moderate if more than 6 percent.	Low to moderate	Low.
Moderate: subsoil fairly stable, substratum relatively unstable; erodible slopes.	Moderate: liquefies easily; subject to frost heave; low bearing capacity; erodible on slopes.	Slight if slope is 2 to 6 percent, moderate if more than 6 percent.	Low to moderate	Low.
Moderate: subsoil and substratum moderately plastic to highly plastic; elastic; moderate shrink-swell potential.	Moderate: moderate shrink-swell potential; high compressibility; poor shear strength.	Severe: clayey soil moderately slowly permeable.	High	Low.
Moderate: fluctuating water table; sandy subsoil has good stability when wet; substratum has moderate shrink-swell potential; low bearing capacity when wet.	Moderate: fluctuating water table; moderate shrink-swell potential; low bearing capacity.	Very severe: fluctuating high water table: moderately slowly permeable substratum.	Low	Low.
Slight	Slight	Moderate: fluctuating water table at a depth of 3 to 5 feet.	Low	Low.
Severe: subsoil has moderate shrink-swell potential and low bearing capacity; substratum is relatively unstable.	Severe: liquefies easily; subject to frost heave; low bearing capacity.	Severe: fluctuating high water table, moderately slow permeability.	High	Low.
Slight	Slight	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if greater than 12 percent; danger of ground water contamination.	Low	Low.
Very severe: high water table; low stability and bearing capacity.	Very severe: high water table; low stability and bearing capacity.	Very severe: high water table.	Very high in organic soil; moderate in underlying mineral soil.	Low when pH is more than 5.5.

TABLE 8.—*Engineering interpretations of soils*

Soil series and map symbols	Suitability as a source of—	
	Topsoil	Sand and gravel
Pardeeville. Mapped only with Lapeer soils.		
*Plainfield: PfC2, PfD2	Surface layer and subsoil unsuitable: subject to blowing; low available water capacity.	Good
PlA, PlB, PlC, PlD2, PnB, PnC, PnE. For ratings of Wyocena soil in PnB, PnC, PnE, see Wyocena series.	Surface layer and subsoil unsuitable: subject to soil blowing; low available water capacity.	Good
Poygan: Po, Ps	Surface layer fair: poor tilth; subsoil unsuitable; clayey; high water table.	Unsuitable: no sand and gravel
Rollin: Ro	Poor: erodible; oxidizes rapidly; high water table.	Unsuitable: no gravel or sand
Seward: SeA, SeB	Surface layer fair: droughty; subsoil fair in upper part, poor in lower part; clayey substratum.	Unsuitable: no gravel or sand
Sisson: SoA, SoB2, SsA, SsB	Surface layer fair: droughty; subsoil fair; unstable slopes.	Poor: substratum contains poorly graded fine sand and silt layers.
Steep sandy land: StF	Unsuitable: thin, droughty; erodible	Good: substratum generally poorly graded sand that contains some fines in places.
Tedrow: TdA, TeA, TfA, TlA	Surface layer fair: droughty; subsoil unsuitable: low available water capacity; subject to soil blowing.	Good except TeA and TlA loamy substratum.
Wyocena: WoB, WoC, WoD, WoE, WyB, WyC2.	Surface layer fair: low available water capacity; subject to soil blowing.	Fair: substratum is well-graded sand with some pockets of gravel.
Yahara: YaA	Surface layer fair: droughty; subsoil unstable on slopes.	Poor: substratum contains poorly graded fine sand with silt layers in some places.

[1] Engineers and others should not apply specific values to the estimates given for bearing capacity of soils.

for town and country planning—Continued

Limitations for—			Corrosion potential for conduits	
Transportation systems [1]	Foundations for low buildings [1]	Onsite sewage disposal	Metal	Concrete
Slight if slope is 0 to 6 percent, moderate for steeper soils: subject to blowing; erodible slopes.	Slight	Moderate: severe if slope is greater than 12 percent; danger of ground water contamination.	Low	Low.
Slight if slope is 0 to 6 percent, moderate on steeper soils: erodible slopes.	Slight	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if greater than 12 percent: danger of ground water contamination.	Low	Low.
Very severe: high water table; subsoil and substratum very elastic; high shrink-swell potential.	Very severe: high water table; high shrink-swell potential; poor shear strength; high to very high compressibility.	Very severe: high water table; very slow permeability.	High	Low.
Very severe: high water table; low stability and bearing capacity.	Very severe: high water table; low stability and bearing capacity.	Very severe: high water table.	Very high	Low.
Moderate: sandy subsoil, good stability; substratum has low bearing capacity and moderate shrink-swell potential.	Moderate: moderate shrink-swell potential; moderately high compressibility; low bearing capacity.	Severe: slowly permeable	Low	Low.
Moderate: subsoil has moderate shrink-swell potential and low bearing capacity; erodible slopes; substratum relatively unstable.	Slight: may become liquid easily; subject to frost heave and loss of bearing capacity on thawing; erodible slopes.	Slight: moderately permeable soil material.	Low to high	Low.
Surface layer moderate: steep slopes are erodible; subsoil and substratum are stable under wheel loads when damp; lacks cohesiveness when dry.	Moderate: steep slopes erodible; very low compressibility; good shear strength; flows during excavation if saturated.	Very severe: steep slopes interfere with construction and design; lateral movement of effluent to surface.	Low	Low.
Moderate: fluctuating high water table; subsoil and substratum are stable under wheel loads when damp; lacks cohesiveness when dry.	Moderate: fluctuating high water table; very low compressibility, good shear strength; flows if saturated during excavation.	Severe: fluctuating high water table.	Moderate to low	Low.
Slight	Slight	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if greater than 12 percent: danger of ground water contamination.	Low	Low.
Severe: fluctuating high water table; subsoil and substratum relatively unstable.	Moderate: fluctuating high water table; becomes liquid easily; subject to frost heave; low bearing capacity.	Severe: fluctuating high water table.	Moderate	Low.

TABLE 9.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in the series is made up of two or more kinds of soil that other series that are

Soil series and mapping symbols	Soil features affecting—	
	Farm ponds	
	Reservoirs	Embankments
Adrian: Ac, Ad	Moderately rapid permeability; high water table; suitable for dugout ponds.	Very pervious; low stability; substratum has high stability but is subject to piping.
Adrian, stratified subsoil variant: Ae, Ak	Moderately rapid permeability; high water table; suitable for dugout ponds.	Very pervious; low stability; substratum has high stability but is subject to piping.
Alluvial land:		
Am	Extremely variable	Extremely variable
An	Extremely variable	Extremely variable
Ankeny: Ao	Moderately rapid permeability.	Semipervious; subsoil has medium stability; low shrink-swell potential.
*Boyer: BmB, BmC2, BmD2, BmE2, BnB, BnC2, BnD2, BrB, BrC2. For features of Oshtemo soils in BrB and BrC2, see Oshtemo series.	Moderately rapid permeability; sandy substratum.	Semipervious to pervious subsoil; high stability: low shrink-swell potential.
Boyer, dark surface variant: BoA, BoB, BoC2.	Moderately rapid permeability; sandy substratum.	Semipervious to pervious subsoil; high stability; low shrink-swell potential.
Briggsville: BsA, BsB, BsC2, BsD2, BvA, BvB.	Moderately slow permeability	Impervious; medium to low stability; moderate shrink-swell potential.
Casco: CaB, CaC2, CaD2, CaE2	Moderately permeable subsoil; rapidly permeable gravelly substratum.	Semipervious subsoil; very pervious substratum has high stability; low shrink-swell potential.
Colwood: Co	Moderately permeable; high water table; suitable for dug-out ponds.	Semipervious to impervious; low stability and moderate shrink-swell potential; susceptible to piping.
Delton: DeB, DeC2, DfA, DfB, DfC2	Clayey substratum is slowly permeable	Semipervious; highly stable subsoil with low shrink-swell potential; clayey substratum subject to piping.
Fox: FmB, FmC2, FoB, FoC2	Moderately permeable subsoil; rapidly permeable gravelly substratum.	Semipervious subsoil; high stability and low shrink-swell potential; very pervious substratum.
Gotham: GlA, GlB, GlC, GlD, GmA, GmB, GmC2, GmD2, GnA, GnB, GoA.	Rapidly permeable	Pervious; high stability; subject to piping; low shrink-swell potential.
Granby: Gr, Gs, Gt	Rapidly permeable; high water table; suitable for dug-out ponds.	Pervious; susceptible to piping; low shrink-swell potential.
Houghton: Hm	Moderately rapid permeability; high water table; suitable for dug-out ponds.	Pervious; low stability
Houghton, acid variant: Hp	Moderately rapid permeability; high water table; suitable for dug-out ponds.	Very pervious; low stability

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may have different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to in the first column]

Soil features affecting—Continued			
Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Rapid permeability; high water table; organic soil less than 30 inches deep in Ad.	Rapid water intake rate; high available water capacity; high water table.	Nearly level; high water table	Highly erodible; wetness hinders construction.
Rapid permeability; high water table; organic soil less than 30 inches deep in Ak.	Rapid water intake rate; high available water capacity; high water table.	Nearly level; high water table	Highly erodible; wetness hinders construction.
Variable texture; overflow hazard	Extremely variable	Frequent flooding; nearly level	Generally not required.
Variable texture; high water table; overflow hazard.	Extremely variable	Nearly level; frequent flooding	Generally not required.
Drainage adequate	Moderate to rapid water intake rate; medium available water capacity.	Somewhat erodible for diversions; terraces not needed.	Some difficulty in establishing vegetation.
Drainage somewhat excessive	Very rapid water intake rate; low available water capacity; subject to soil blowing.	Sandy loam profile; subject to soil blowing and water erosion.	Difficult to establish and maintain vegetation.
Drainage somewhat excessive	Very rapid water intake rate; low available water capacity; subject to soil blowing.	Sandy loam profile; subject to soil blowing and water erosion.	Difficult to establish and maintain vegetation.
Natural drainage is adequate	Moderately slow water intake rate; high available water capacity.	Moderately slow permeability	Difficult to establish grass in clayey subsoil.
Natural drainage is adequate	Moderately rapid water intake rate; low available water capacity.	Shallow to gravelly and sandy substratum; moderately permeable.	Vegetation difficult to establish where gravelly substratum is exposed.
Moderate permeability; high water table.	Moderate water intake rate; high available water capacity; high water table.	Nearly level; poorly drained	Highly erodible; wetness hinders construction.
Natural drainage is adequate	Rapid initial water intake rate; medium available water capacity; slowly permeable substratum.	Sandy profile subject to erosion; slowly permeable substratum.	Difficult to maintain and establish vegetation.
Natural drainage is adequate	Moderate water intake rate; medium available water capacity.	No limiting factors	Vegetation easy to establish where the gravelly substratum is not exposed.
Natural drainage is excessive	Rapid water intake rate; low available water capacity; subject to soil blowing.	Sandy loam profile is highly erodible.	Difficult to establish and maintain vegetation.
Rapidly permeable; high water table.	Rapid water intake rate; low available water capacity; high water table.	Nearly level; poorly drained	Highly erodible; wetness hinders construction.
Moderately rapidly permeable; high water table.	Rapid water intake rate; high available water capacity; high water table.	Nearly level; high water table	Highly erodible; wetness hinders construction in many places.
Generally not feasible	Generally not feasible	Not feasible	Wetness hinders construction.

TABLE 9.—*Engineering interpretations*

Soil series and mapping symbols	Soil features affecting—	
	Farm ponds	
	Reservoirs	Embankments
Keowns: Ke	Moderate permeability; high water table; suitable for dug-out ponds.	Semipervious; very low stability; susceptible to piping; low shrink-swell potential.
*Lapeer-Pardeeville: LpB, LpC2, LpD2, LpE2. Features apply to both Lapeer and Pardeeville soils in each unit.	Moderate permeability; sandy substratum	Semipervious to impervious; high stability; some areas are stony; low shrink-swell potential.
Lorenzo: LrA, LrB	Moderately permeable; gravelly substratum.	Semipervious; substratum has high stability; low shrink-swell potential.
Marsh: Ma	Variable	Variable
Mecan: McD2, McE2, MeB, MeC2	Moderately rapid permeability	Semipervious; high stability; susceptible to piping; low shrink-swell potential.
Metea: MfB, MfC2, MfD, MlB, MlC2, MmB, MmC, MmD2, MnB, MnC2, MoA, MoB, MoC.	Moderate permeability; sandy substratum	Semipervious; high stability; low shrink-swell potential.
Montello: MrA, MrB, MsA, MsB	Moderately slowly permeable	Impervious; medium to low stability; high shrink-swell potential.
Mosel: MtA, MuA	Moderately slowly permeable; clayey substratum.	Semipervious; highly stable subsoil; low shrink-swell potential; clayey substratum; subject to piping.
Moundville: MvA, MwA	Rapid permeability	Pervious; high stability; susceptible to piping; low shrink-swell potential.
Mundelein: MxA, MyA	Moderately slow permeability; fluctuating high water table.	Semipervious to impervious; low stability; moderate shrink-swell potential; susceptible to piping.
Oshtemo: OsA, OsB, OsC2, OsD2, OtA, OtB, OtC2.	Moderately rapid permeability; sandy substratum.	Pervious subsoil; high stability; low shrink-swell potential.
Palms: Pa, Pc	Moderately rapid permeability; high water table; suitable for dug-out ponds.	Pervious organic soil has low stability; substratum is unstable.
Pardeeville. Mapped only with Lapeer soils.		
*Plainfield: PfC2, PfD2, PlA, PlB, PlC, PlD2, PnB, PnC, PnE. For features of Wyocena soils in PnB, PnC, PnE, see Wyocena series.	Very rapidly permeable	Pervious; high stability; susceptible to piping; low shrink-swell potential.
Poygan: Po, Ps	Slowly permeable; high water table; suitable for dug-out ponds.	Impervious; medium to low stability; high shrink-swell potential.

of soils for farming—Continued

Soil features affecting—Continued			
Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Moderate permeability; high water table.	Moderate water intake rate; medium available water capacity; adequate drainage difficult to obtain.	Low stability; nearly level; poor drainage.	Highly erodible; wetness hinders construction in many places.
Natural drainage is adequate---	Moderate water intake rate; medium available water capacity.	Stones may hinder construction.	Vegetation fairly easy to establish except where sandy substratum is exposed.
Natural drainage is adequate----	Moderate water intake rate; low available water capacity.	Shallow to gravelly and sandy substratum.	Vegetation can be established where gravel substratum is not exposed.
High water table most of the year; drainage not feasible in most places.	Generally not feasible----------	Wetness hinders construction---	Wetness hinders construction.
Natural drainage is excessive----	Moderately rapid water intake rate; low available water capacity.	Sandy profile; erodible---------	Somewhat difficult to establish and maintain vegetation, especially if slope is greater than 6 percent.
Natural drainage is adequate----	Moderately rapid water intake rate; medium available water capacity.	Somewhat erodible----------	Difficult to establish and maintain vegetation, especially if slope is greater than 12 percent.
Moderately slow permeability---	Moderate water intake rate; high available water capacity.	Moderately slow permeability--	Somewhat difficult to establish grass in clayey subsoil.
Moderately slowly permeable lower profile; periodic high water table.	Moderate water intake rate; moderately slow permeability in subsoil; high available water capacity except in subsoil; high water table.	Nearly level; high water table--	Periodic wetness hinders construction.
Natural drainage is adequate----	Rapid water intake rate; low available water capacity; subject to soil blowing.	Sandy profile is highly erodible--	Difficult to establish and maintain vegetation.
Moderately slow permeability; fluctuating high water table.	Moderate water intake rate; high available water capacity; periodic high water table.	Nearly level; high water table--	Highly erodible; periodic wetness hinders construction.
Natural drainage is excessive----	Very rapid water intake rate; low available water capacity; subject to soil blowing.	Sandy profile subject to erosion--	Very difficult to establish and maintain vegetation, especially if slope is greater than 12 percent.
Moderately rapid permeability; high water table.	Rapid water intake rate; very high available water capacity; high water table.	Low stability; highly erodible--	Highly erodible; wetness hinders construction.
Natural drainage is excessive----	Very rapid water intake rate; low available water capacity; subject to soil blowing.	Sandy profile highly erodible----	Very difficult to establish and maintain vegetation, especially if slope is greater than 6 percent; highly erodible.
Slowly permeable; high water table.	Slow water intake rate; high available water capacity; high water table.	Nearly level; high water table---	Difficult to establish grass in clayey subsoil.

TABLE 9.—*Engineering interpretations*

Soil series and mapping symbols	Soil features affecting—	
	Farm ponds	
	Reservoirs	Embankments
Rollin: Ro	Moderately rapid permeability; high water table; suitable for dug-out ponds.	Pervious; both organic soil and marl have low stability.
Seward: SeA, SeB	Slowly permeable; clayey substratum	Semipervious; highly stable subsoil, low shrink-swell potential; clayey substratum; subject to piping.
Sisson: SoA, SoB2, SsA, SsB	Moderately permeable	Semipervious; low stability; low shrink-swell potential; susceptible to piping.
Steep sandy land: StF	Rapidly permeable; steep slopes	Pervious; high stability; susceptible to piping; low shrink-swell potential.
Tedrow: TdA, TeA, TfA, TlA	Rapidly permeable	Pervious; high stability; susceptible to piping; low shrink-swell potential.
Wyocena: WoB, WoC, WoD, WoE, WyB, WyC2.	Moderately rapid permeability; sandy reservoir bottom.	Semipervious; low shrink-swell potential.
Yahara: YaA	Moderately permeable	Semipervious; low stability; susceptible to piping; low shrink-swell potential.

The column showing reaction indicates the estimated acidity or alkalinity of the soils and is expressed in pH. A neutral soil has a pH of 6.5 to 7.3. A pH value lower than 6.6 indicates acidity, and a pH value higher than 7.3 indicates alkalinity. A knowledge of the pH of soil horizons can be used to indicate the need for liming and for determining the hazard of corrosion for metal conduits and the risk of deterioration for concrete tile.

The shrink-swell potential refers to the change in volume of the soil that results from a change in moisture content. It is based on volume-change tests or on observation of other physical properties of the soils. The amount and kind of clay and the content of organic matter in the soils affect the shrink-swell behavior. Soils in which illite clays are predominant, for example, do not have so high a shrink-swell ratio as soils in which montmorillonite clays are predominant.

Engineering interpretations

Interpretations of engineering properties of the soils in Marquette County are given in table 8 and 9. Table 8 lists rural fringe uses and table 9 lists farm uses. Some items, however, are useful to both groups. Soil characteristics that affect the selection, design, or application of treatment measures are mentioned, and suitability or limitation ratings for specific purposes are given.

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means soil properties are generally favorable for the rated use, or in other words, limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means that soil properties are so unfavorable and so difficult to correct or overcome that major soil reclamation and special designs are required. For some uses, the rating of severe is divided to obtain ratings of severe and very severe. *Very severe* means one or more soil properties so unfavorable for a particular use that overcoming the limitations is most difficult and costly and commonly not practical for the rated use.

Soil suitability is rated by the terms *good*, *fair*, and *poor*, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

In table 8, the suitability of the soils as a source of *topsoil* refers to the use of soil as a topdressing for roadbanks, parks, gardens, and lawns. The ratings are based on the texture of the soil and on its content of organic matter. For example, a soil that is medium textured and high in organic matter has a suitability rating of good as a source of topsoil. On the other hand, a soil that is very fine or coarse textured and low in organic matter is regarded as poor or unsuitable.

The column showing the suitability of soils as a source of *sand and gravel* indicate soils that are underlain by sand and gravel within a depth of 5 feet (fig. 12). No distinction is made between mainly coarse-grained deposits and coarse-grained deposits with appreciable amounts of fines. Individual test pits and laboratory analyses will be needed to make these determinations.

of soils for farming—Continued

Soil features affecting—Continued			
Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Moderately rapid permeability; high water table.	Rapid water intake rate; high available water capacity; in thin organic soil, adequate drainage is difficult.	Nearly level; high water table	Highly erodible where marl is not exposed; wetness hinders construction.
Natural drainage is adequate	Rapid water intake rate; slowly permeable subsoil; medium available water capacity.	Sandy loam profile; subject to erosion.	Difficult to maintain and establish vegetation.
Natural drainage is adequate	Moderate water intake rate; high available water capacity.	Substratum has low stability and is highly erodible.	No limiting factors.
Natural drainage is excessive	Rapid water intake rate; low available water capacity; steep slopes.	Sandy profile; highly erodible; steep slopes.	Very difficult to establish and maintain vegetation because of sandy profile and steep slopes.
Rapidly permeable; periodic high water table.	Rapid water intake rate; low available water capacity; periodic high water table.	Nearly level; high water table	Somewhat difficult to establish and maintain vegetation.
Natural drainage is excessive	Rapid water intake rate; low available water capacity.	Sandy profile; erodible	Somewhat difficult to establish and maintain vegetation.
Moderately permeable; seasonal water table.	Rapid water intake rate; high available water capacity; periodic high water table.	Nearly level; somewhat poorly drained.	Highly erodible; wetness hinders construction.

The characteristics and qualities that affect the overall performance of the soil for the location and construction of highways, railroad beds and airports were evaluated in the column under *transportation systems*. Commonly, only the subsoil and underlying material are considered, and ratings are for undisturbed soil without artificial drainage. Factors considered are texture, presence and thickness of organic soil, depth to bedrock and presence of stones and boulders, depth to water table, flooding hazard, susceptibility to frost heave, stability of slopes, bearing capacity, and need for cut and fill operations.

The factors limiting the use of soils for *foundations for low buildings* are mainly slope, drainage, texture, depth to bedrock and ease of establishing grass. The hazard of erosion is greater on steep slopes than on gentle slopes, and susceptibility to land slippage is greater. Surface runoff, flooding, and high ground water tables contribute to flotation of sewage pipes, difficulty of installation and maintenance of public utilities and access roads, and wet basements. Soil texture is the main factor that determines shrink-swell behavior, susceptibility to liquefaction, bearing capacity, and other factors important to residential development. Bedrock is a major limitation only where it is near enough to the soil surface to impede excavations for basements. Vegetation is difficult to establish on soils that have sand or clay texture.

Suitability of soils for *onsite sewage systems* depends on their ability to absorb and dispose of sewage effluent without contamination of surrounding areas. Those soils having moderate to severe limitations require onsite investigation and appropriate tests before suitability can be determined. How well a sewage system works depends mainly on the rate at which the septic tank effluent moves into and through the soil. The soil permeability should be moderate to rapid, with a percolation rate of 60 minutes per inch or faster. Other important factors are structural stability, depth to the water table, depth of the soil, types of underlying material, susceptibility to stream overflow, slope, and proximity to streams and lakes. Where slopes are more than 12 percent, filter fields are difficult to lay out and construct and seepage beds are impractical. Where slopes are very steep the effluent often flows laterally and seeps out on the ground surface.

The *corrosion potential* of soils for underground metal pipes and concrete conduits is closely related to soil reaction, drainage, and electrical conductivity of the soil solution. Most conduits are laid in the lower part of the soil or underlying material. Generally, poor aeration and high pH values, or high carbonate content, and high moisture content are characteristic of soils that are corrosive to metal conduits. Soils with low pH values are the most corrosive for concrete conduits. In both cases corrosion is more rapid when the moisture content of the soil is high. The ratings given are low, medium, and high, and are based on relative corrosiveness.

Table 9 gives interpretations mainly for farm use. Characteristics and qualities that limit use of the soil for both *reservoir areas* and *embankments* are given under pond development. They are ground water level,

Figure 12.—**This gravel pit in Lorenzo loam is a source of construction and road building materials.**

permeability, stoniness or depth to bedrock, strength and stability, shrink-swell potential, and organic-matter content. Unless otherwise specified, the entire soil profile is considered in these evaluations. The evaluations given for reservoirs are for undisturbed soils, but the evaluations given for embankments are for soil materials that have been disturbed. Controlled compaction of embankments commonly results in increased density and lowered permeability. The terms "subsoil" and "underlying material" in the embankment column refer to soil materials that have been removed from these horizons and placed in the embankment.

Some of the factors to be considered in *drainage* of soils are rate of water movement into and through the soil, restricting layers, depth to water table, and topographic positions. Both surface and subsurface drainage are considered.

Some of the characteristics and qualities of the soil that are important in *irrigation* are soil depth, available water capacity, permeability, natural drainage, and rate of intake of water.

Features that are considered in evaluating soils for *terraces and diversions* are soil stability, texture and thickness of soil material, stoniness and rockiness, and topography. Broad base terraces are not suitable for slopes of more than 12 percent, but diversions can be used on steeper slopes.

Suitability of soils for *grassed waterways* depends on soil stability, texture and thickness of soil material, ease in establishing and maintaining a suitable vegetative cover, and soil slope.

Formation and Classification of the Soils

This section consists of two main parts. The first part tells how the factors of soil formation have affected the development of soils in Marquette County. The second explains the system of soil classification currently used and places each soil series in the classes of that system.

Factors of Soil Formation

Soil is produced by soil-forming processes that act on geologic deposits. The characteristics of the soil at any given point are determined by (1) the physical and mineral composition of the parent material; (2) the climate under which the geologic deposit has accumulated and existed since accumulation; (3) living organisms, the

plant and animal life on and in the soil; (4) the relief, or landforms and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are the active factors of soil formation. They act on accumulated weathered rocks and slowly change them to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

The mineral soils of Marquette County are derived from various kinds of glacial drift. The glacial drift was deposited during the Cary substage of the Wisconsin Glaciation. The major kinds of drift are glacial till, glaciofluvial deposits (outwash), or glaciolacustrine sediments. Some of the glacial drift has been redeposited by the action of wind and water and has affected some of the soils of the county.

The organic soils are derived from decaying remains of plants. These soils are underlain at various depths by glaciofluvial and glaciolacustrine materials. In some areas they are underlain by marl.

The glacial till soils formed mainly in calcareous sandy loam till, calcareous loamy sand till, and deeply leached loamy sand to sand till.

The calcareous sandy loam glacial till is mainly in the southeastern part of Marquette County. It has a higher dolomitic gravel and carbonate content than the other glacial tills of the county. The Lapeer and Pardeeville soils formed in this kind of till. Where a coarse-textured upper story overlies this till, the Metea soils formed.

The calcareous loamy sand glacial till occurs randomly throughout the county. It has a somewhat lower dolomitic gravel and carbonate content than the sandy loam till. The Mecan soils formed in this till and are on upland morainic areas of the county. Where a thick coarse-textured upper story overlies this till, a loamy substratum phase of the Gotham soils formed.

The loamy sandy to sand till is throughout the county, but most of it is in the northwestern part. This till formed mainly in material weathered from nondolomitic rocks and minerals, including unconsolidated Cambrian Sandstone, and is leached to a greater depth than other kinds of till. The Wyocena soils formed in this till and in most places are in upland morainic areas of the county, including many steep hills and ridges.

The glaciofluvial soils formed primarily in calcareous glacial outwash, neutral to calcareous sandy outwash, and acid outwash. The calcareous outwash is generally more gravelly than the acid outwash. The dolomite gravel content of the calcareous outwash is quite variable. The calcareous outwash is mainly in the east-central part of the county. Soils formed in calcareous outwash are those of the Fox, Casco, Boyer, Oshtemo, Lorenzo, and Boyer, dark surface variant series. Variations in the dolomitic gravel and carbonate content of outwash and variations in the native vegetation are responsible for the large number of series that formed in this parent material. The substratum of the Fox, Casco, and Lorenzo soils generally contains more dolomitic gravel than the calcareous outwash under other soils. The Oshtemo soils formed in calcareous outwash that has a relatively low dolomitic gravel content. The Boyer soils and their dark surface variant formed in calcareous outwash that has an intermediate carbonate and dolomitic gravel content.

Soils formed in the neutral to calcareous sandy outwash are of the Tedrow and Granby series. Because there is little evidence of dolomitic gravel in the neutral to calcareous sandy outwash, the reaction is probably due to the carbonate content of the ground water table.

The acid outwash is mainly quartz sand that has a relatively low weatherable mineral content. The acid outwash occurs throughout the county, but mainly in the northern part. It occupies level to sloping terraces and sloping to steep upland areas. Soils formed in acid outwash are the Gotham, Plainfield and Moundville soils. The Gotham soils formed in acid outwash that has a somewhat finer textured upper story than usual and a somewhat darker-colored surface layer. Moundville soils are affected by a higher ground water table than the Gotham or Plainfield soils. The Plainfield soils have little horizonation because mostly the soil consists of very slowly weatherable quartz sand.

The glaciolacustrine soils formed mainly in stratified silt and clay and stratified silt and fine sand.

The Briggsville, Montello, and Poygan soils formed in the glaciolacustrine silt and clay that occurs throughout most of the county but is distributed in greatest extent in the western part. The carbonate content of these sediments is somewhat variable, but reaction is generally more alkaline in the lower part. The Poygan soils have a higher percentage of clay in the sediments than do the Montello and Briggsville soils. Where a sandy or sandy loam upper part of the profile overlies the lacustrine silt and clay, the Delton, Seward, and Mosel soils formed.

The Sisson, Mundelein, Yahara, Colwood, and Keowns soils formed in glaciolacustrine silt and fine sand that occurs throughout the county. The carbonate content of these sediments is quite variable. The pH is generally higher in the lower part of the profile than in the upper part. Where the glaciolacustrine silt and fine sand underlies thick sandy loam in the upper part of the profile, loamy substratum phases of the Tedrow and Granby soils occur.

The Adrian, Houghton, and Palms soils that formed in organic deposits occur randomly throughout Marquette County, but the largest areas are in the south-central part. The organic soils range widely in depth and consist mainly of decayed sedges, grasses, and reeds. There are thin layers of less decomposed fibrous plant residues in the muck and mucky peat. The organic soils in the county are underlain by lacustrine silt and clay, lacus-

trine silt and fine sand, loose sand, and marl. Soils of the Houghton series are more than 48 inches deep over mineral deposits. Where the pH is 5.5 or less, the acid variant of the Houghton series occurs.

Climate

Marquette County has the cool continental type climate characteristic of the north-central part of the United States. Climate affects soil formation through the precipitation and heat energy it contributes to the environment. It influences soils both directly and indirectly. It acts indirectly through organisms, for which it supplies energy and a suitable environment. Climate is of special significance in organic-matter accumulation and increased soil fertility, as shown in the Lorenzo, Pardeeville, and Boyer, dark surface variant, soils.

Soils on extensive land areas, such as continents, are affected by general or macroclimatic conditions. A small localized area of soils, such as that in Marquette County, however, may be modified locally by variations in relief and by aspects of slopes. This indirect effect of climate slows the physical, chemical, and biological agents of weathering and decreases the rate of soil formation.

Living organisms

Plants and animals in and on the soil chiefly provide vegetative cover and organic-matter accumulation. Bacteria, fungi, earthworms, and even man are regarded as important in furnishing organic matter for the soil and in the translocation of plant nutrients from lower to upper horizons.

The first settlers found a vegetative cover that is little changed, with respect to species, from the present vegetation of Marquette County. It consists dominantly of oak, some jack pine, and many prairie grasses and forbs. The finer textured soils support mixed hardwoods, including white and red oaks. Prairie plants are throughout the county.

In places where the vegetation was a mixture of trees and grasses, there occurs a complex association of soils influenced by forest vegetation, such as the Lapeer soils, and soils influenced by prairie vegetation, such as the Pardeeville soils. The darker Pardeeville soils have apparently formed in small grassed openings in the complex vegetative association of prairie and forest communities. Organic soils, such as the Houghton series, seem to have developed mainly from sedges, grasses, and reeds that are the dominant vegetative cover of present marshes. Tamarack is the dominant tree encroaching upon the marshy areas to form swamps. Local bog areas are supporting a vegetation of sphagnum and bog blueberry, such as grows on the Houghton, acid variant soils.

Relief

Relief influences the formation of soils in the county by controlling depth to ground water, thickness and organic matter of the surface layer, thickness of the solum, and degree of horizonation. The numerous recessional moraines, pitted plains, outwash and till plains, kames, eskers, and lacustrine basins caused by the Wisconsin Glaciation account for much variety in the topography of the county.

Drainage characteristics are generally reflected in the color of the soil and in the degree and kind of mottling or gleying in the soil profile. The Mecan, Lapeer, and Wyocena soils of the uplands, as well as the Oshtemo, Gotham and Plainfield soils of outwash plains, are all well-drained soils. All are free of mottling in the A and B horizons, but may be mottled in the C horizon or below. Ground water is at depth of more than 5 feet throughout the year.

In contrast, soils such as those of the Montello series have mottling in part of the B horizon and in the C horizon. In these soils, ground water is at a depth of 3 to 5 feet in wet periods. The Mundelein and Tedrow soils commonly have mottling in the lower part of the A horizon and in the B and C horizons, and ground water is 1 to 3 feet below the surface in wet seasons.

The Granby and Colwood series are characterized by a very dark colored, organic-mineral surface horizon underlain by mineral gley horizons. Ground water is at or near the surface throughout the year.

The thickness of the surface layer and its content of organic matter are commonly related, indirectly, to topography. In less sloping areas runoff is slower and the soils absorb more moisture than on steeper slopes. As a result, the content of moisture in the less sloping soils is more favorable for plant growth and organic-matter accumulation.

In areas that are low or basinlike, the soils are likely to be waterlogged. In some extremely wet areas, decomposing plant remains accumulate to a depth of several feet to form organic soils, such as those of the Adrian, Palms, Rollin, and Houghton series.

Topography also affects the thickness of the solum and the degree of horizon differentiation. The soils that have steep slopes generally are shallower and have less horizon development.

Time

Time is required by the active agents of soil formation to develop soils from parent material. Some soils develop rapidly, others slowly. The length of time required for the formation of a given type of soil depends on the other soil-forming factors.

Most of the soils of Marquette County formed glacial drift of the Cary substage of the Wisconsin Glaciation. The time allowed for their formation has been estimated as about 11,000 years. This is the apparent time interval since the last ice advance.

During the early development of soils, the soil material is similar to that of the parent material. An example of such a soil is the Ankeny soil. Its lack of clay accumulation or oxidation of minerals in the subsoil is because of recent deposition. Soil materials of the Ankeny soils have been deposited within the past 100 years.

The Briggsville soil is an example of a soil that has had more time to develop. This is shown by accumulation of clay in the subsoil. This clay has moved down from the surface soil. It is also shown by oxidation of minerals in the subsoil that give it a reddish-brown color in most soils.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to re-

member soil characteristics and interrelationships. Classification is useful in organizing and apply the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

The system of classifying soils used in the United States in recent years was developed in the early sixties (*2*) and was adopted by the National Cooperative Soil Survey in 1965 (*4*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 10 shows the classification of each soil series of Marquette County by family, subgroup, and order, according to the current system.

ORDER.—Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. The five soil orders in Marquette County are Alfisols, Entisols, Histosols, Inceptisols, and Mollisols.

Alfisols are soils that have clay-enriched B horizons that are high in base saturation. In Marquette County, this order comprises most of the soils that were formerly called Gray-Brown Podzolic soils.

TABLE 10.—*Classification of soil series by higher categories*

Series	Family	Subgroup	Order
Adrian	Sandy, mixed, euic, mesic	Terric Medisaprists	Histosols.
Adrian, stratified subsoil variant.	Loamy, mixed, euic, mesic	Terric Medisaprists	Histosols.
Ankeny [1]	Coarse-loamy, mixed, mesic	Cumulic Hapludolls	Mollisols.
Boyer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Boyer, dark surface variant.	Coarse-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
Briggsville	Fine, mixed, mesic	Typic Hapludalfs	Alfisols.
Casco	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Hapludalfs	Alfisols.
Colwood [2]	Fine-loamy, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Delton	Coarse-loamy over clayey, mixed, mesic	Arenic Hapludalfs	Alfisols.
Fox	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Hapludalfs	Alfisols.
Gotham	Sandy, mixed, mesic	Psammentic Hapludalfs	Alfisols.
Granby [3]	Sandy, mixed, mesic	Typic Haplaquolls	Mollisols.
Houghton	Euic, mesic	Typic Medisaprists	Histosols.
Houghton, acid variant.	Dysic, mesic	Typic Medisaprists	Histosols.
Keowns [4]	Coarse-loamy, mixed, calcareous, mesic	Mollic Haplaquepts	Inceptisols.
Lapeer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Lorenzo	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Argiudolls	Mollisols.
Mecan	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Metea	Fine-loamy, mixed, mesic	Arenic Hapludalfs	Alfisols.
Montello	Fine, mixed, mesic	Typic Argiudolls	Mollisols.
Mosel	Fine-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Moundville	Sandy, mixed, mesic	Psammentic Hapludalfs	Alfisols.
Mundelein [5]	Fine-silty, mixed, mesic	Aquic Argiudolls	Mollisols.
Oshtemo	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Palms	Loamy, mixed, euic, mesic	Terric Medisaprists	Histosols.
Pardeeville	Coarse-loamy, mixed, mesic	Mollic Hapludalfs	Alfisols.
Plainfield	Sandy, mixed, mesic	Typic Udipsamments	Entisols.
Poygan	Fine, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Rollin	Marl, euic, mesic	Limnic Medisaprists	Histosols.
Seward	Coarse-loamy over clayey, mixed, mesic	Arenic Hapludalfs	Alfisols.
Sisson	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Tedrow	Sandy, mixed, mesic	Aquic Udipsamments	Entisols.
Wyocena	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Yahara [6]	Coarse-loamy, mixed, mesic	Aquic Hapludolls	Mollisols.

[1] These soils are taxadjuncts to the Ankeny series because they are medium acid and occur near the 40° line in Marquette County.

[2] These soils are taxadjuncts to the Colwood series because they have a slightly acid B horizon and chromas higher than 2 in the C horizon.

[3] These soils are taxadjuncts to the Granby series because they have chromas higher than 2 in the C horizon.

[4] These soils are taxadjuncts to the Keowns series because they lack carbonates in the 10- to 20-inch section of the profile and have dominant chromas of 3 or more between the Ap horizon and a depth of 30 inches.

[5] These soils are taxadjuncts to the Mundelein series because they have hues of 7.5YR in the B and C horizons.

[6] These soils are taxadjuncts to the Yahara series because they have horizons more acid than slightly acid, dominant chromas of 2, and hues of 2.5Y or 5Y.

Entisols are recent soils. They are without genetic horizons or have only beginnings of such horizons. In Marquette County this order includes many but not all of the soils previously classified Alluvial soils and Regosols.

Histosols include the soils previously called bog soils or organic soils. Proposals for the further classification of Histosols are being made.

Inceptisols are generally on young but not recent land surfaces; hence their name is derived from the Latin *inceptum*, for beginning. In Marquette County this order includes some soils that were formerly known as Low-Humic Gley soils.

Mollisols are soils that have a mollic epipedon, which is a thick, dark mineral surface layer. In Marquette County, the Mollisols have developed under a grass vegetation and were called Brunizem (Prairie) and Humic Gley soils.

SUBORDER.—Each order has been subdivided into suborders, primarily on the basis of the characteristics that seemed to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUP.—Suborders are separated into great groups on basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that contain a pan that interferes with the growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 10, because it is the last word in the name of the subgroup.

SUBGROUP.—Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the great group.

FAMILY.—Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, clay composition, reaction, soil temperaturre, permeability, thickness of horizons, and consistence.

SERIES.—The series is a group of soils having major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile. Some of the soils in this county do not fit in a series that has been recognized in the classification system, but differ from a named series in ways too insignificant to be of consequence in interpreting their usefulness or behavior. Such soils are taxadjuncts to the series that they strongly resemble.

General Nature of the County

In this section, additional facts about the county are discussed, which include the climate, history and development, transportation, community facilities, and industries in the county. Finally, there is a discussion on farming that includes brief descriptions of types and sizes of farms, crops grown, and permanent pasture. Also discussed are factors concerning livestock and livestock products and farm income.

Climate [4]

The climate of Marquette County is continental. Winters are cold and snowy. They begin in November and last through March, although the first and last months are transitional. Overcast skies are prevalent during the winter, particularly during November and December. Changes in weather can be expected every few days from late in fall through spring, because changing air masses are part of the pressure systems that move eastward along the northern part of the United States and northeastward from the southwest. Summers are warm and fully developed; usually only a few short periods are hot and humid. Spring is slow in coming. As shown in table 11, the low temperatures of winter are moderated early in spring, rather than the high temperatures becoming much more frequent. The change from summer to fall is usually abrupt and occurs in early or mid-September. Nearly every year has one or more periods of Indian Summer when it is abnormally warm, the skies are generally clear, days are sunny but hazy, and nights are cool. Throughout the year there is a tendency toward climatic extremes.

During the last 30 years, 90°F. or higher temperatures were recorded on an average of 18 days a year. During this period 40 days in 1941 and no days from August 1949 to June 1952 had temperatures of 90° or higher. Temperatures of zero or less were recorded on an average of 24 days a year. Extreme years were 1931 and 1936, in which 4 and 42 days respectively had temperatures of zero or less. Heat growth units during the growing season averaged 3,650 above a threshold of 40°; 2,950 above a threshold of 45°; and 2,350 above a threshold of 50°.

The average date of the last 32-degree freeze in spring is May 13, and the first in fall is September 26. The growing season, defined as the number of days between the last 32-degree freeze in spring and the first in fall, averages 135 days.

Table 12 gives the average monthly temperature and precipitation in Marquette County. Table 13 gives relative humidity.

Hilltop elevations tend to decrease the daily and annual temperature ranges, and valleys increase these ranges by lowering the minimum temperatures through cold air pooling.

Precipitation is adequate for farming. Soil moisture is usually adequate for the first part of the growing season, but after June crops depend upon rain that falls

[4] By MARVIN W. BURLEY, former Wisconsin State climatologist, National Weather Service, U.S. Department of Commerce.

TABLE 11.—*Probabilities of last low temperatures in spring and first in fall*

Temperature	Date of probable temperature			
	20 percent probability	40 percent probability	60 percent probabllity	80 percent probability
Spring:				
32° F. or lower, later than	May 23	May 19	May 10	May 3
28° F. or lower, later than	May 10	May 3	April 27	April 20
24° F. or lower, later than	April 27	April 19	April 13	April 5
20° F. or lower, later than	April 14	April 6	March 30	March 22
16° F. or lower, later than	April 2	March 25	March 19	March 11
Fall:				
32° F. or lower, earlier than	September 16	September 23	September 29	October 6
28° F. or lower, earlier than	September 21	September 29	October 5	October 13
24° F. or lower, earlier than	October 6	October 14	October 20	October 28
20° F. or lower, earlier than	October 16	October 24	October 30	November 7
16° F. or lower, earlier than	October 30	November 7	November 13	November 21

TABLE 12.—*Temperature and precipitation data*

[Data recorded at Montello, Wisconsin]

Month	Temperature				Precipitation				
	Average daily		Two years in 10 will have at least 4 days with—		Average total	One year in 10 will have—		Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover
	Maximum	Minimum	Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—		
	°F.	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*		*Inches*
January	27. 8	8. 5	43	−16	1. 12	0. 31	2. 23	24	5
February	30. 8	10. 3	46	−11	1. 07	. 18	2. 38	22	6
March	40. 7	21. 2	62	3	1. 69	. 50	2. 96	20	7
April	57. 6	33. 9	78	22	2. 79	1. 11	5. 00	2	2
May	70. 2	45. 0	85	32	3. 29	1. 61	5. 54	(1)	1
June	79. 4	55. 0	90	43	4. 23	2. 24	6. 44	0	0
July	84. 5	58. 9	95	49	3. 17	1. 28	5. 11	0	0
August	82. 6	56. 6	94	44	3. 14	1. 06	6. 08	0	0
September	74. 1	48. 2	90	33	3. 26	. 85	5. 95	0	0
October	62. 5	38. 1	77	23	2. 01	. 47	4. 46	(1)	1
November	44. 9	25. 6	64	7	2. 02	. 51	3. 59	6	2
December	31. 2	13. 4	47	−8	1. 18	. 32	1. 95	16	4
Year	57. 2	34. 6			28. 97			90	5

[1] Less than half a day.

TABLE 13.—*Seasonal relative humidity*

[Data recorded at Montello and Grand River Locks, Wisconsin]

Humidity level	Frequency of occurrence in—			
	Winter	Spring	Summer	Fall
	Percent	*Percent*	*Percent*	*Percent*
Less than 50 percent	5	20	15	20
From 50 to 80 percent	55	50	45	50
More than 80 percent	40	30	40	30

in showers and tends to be variable. The frequency of dry spells increases late in summer. Approximately 60 percent of the annual precipitation falls in the 5 months of May through September. The possibility of receiving 1 inch or more of rain in a 7-day period during the summer is greatest during the first half of June when it is about 4 in 10 years. The possibility of a dry week, trace or less, during the summer is greatest the last part of August, when it approaches 3 in 10 years. Precipitation intensities of about 1.4 inches in 1 hour, 2.0 inches in 6 hours, and 2.7 inches in 24 hours can be expected once in 2 years. The number of days in a year that have 0.01 inch or more precipitation has averaged 115, and has been between 104 and 126 in 2 or 3 years.

Figure 13.—**Granite at Montello is quarried for monuments and markers. The rock formation has little effect on soil development in the county.**

Annual snowfall averages 35 inches a year, but it is highly variable. Seasonal totals have ranged from 10 to 90 inches. Winters that have little snow allow frost to penetrate from 3 to 6 feet into the soil. The average date of the first 1 inch or more snowfall is November 24. The chance of this fall by October 26 is 1 in 10 years, and by December 25, 9 in 10 years. A snow depth of 1 inch or more can be expected about 10 percent of the time in November, 55 percent in December, 75 percent in January and February, and 40 percent in March.

Thunderstorms occur on an average of 40 days a year, and in individual years the range is from 32 to 60 days. Hail falls on an average of 2 days a year, and the number of occurrences ranges from 0 to 6 days a year. June has the greatest number of days with thunderstorms, and May has the greatest number of days with hail. The most probable time for severe storms is between 2 p.m. and 7 p.m. in July. Since 1916, the county has had six tornadoes.

Prevailing winds are westerly from mid-fall through mid-spring, and southerly the remaining part of the year. March, April, and November are the windiest months and have averages of about 12 miles per hour. July and August are least windy and have averages of about 9 miles per hour. Windspeeds in excess of 50 miles per hour can be expected once in 2 years and are usually from the southwest or west. The wind averages less than 4 miles per hour about 10 percent of the time, from 4 to 12 miles per hour about 50 percent of the time, 13 to 31 miles per hour about 40 percent of the time, and more than 31 miles per hour less than 1 percent of the time.

The percentage of possible sunshine is near 40 during November and December, 60 and greater from May through October, and between 50 and 60 for the remaining months.

History and Development

Marquette County is on the Fox River. It was visited by some of the first Frenchmen who came to Wisconsin. The county was named for one of these, Father Jacques Marquette. The county originally had considerably more territory than it does today; its present boundaries were set in 1858. The first permanent settlers came to the county more than 10 years after the Black Hawk War. They came to the town of Buffalo in the spring of 1848. By the late 1850's the first wave of settlement had

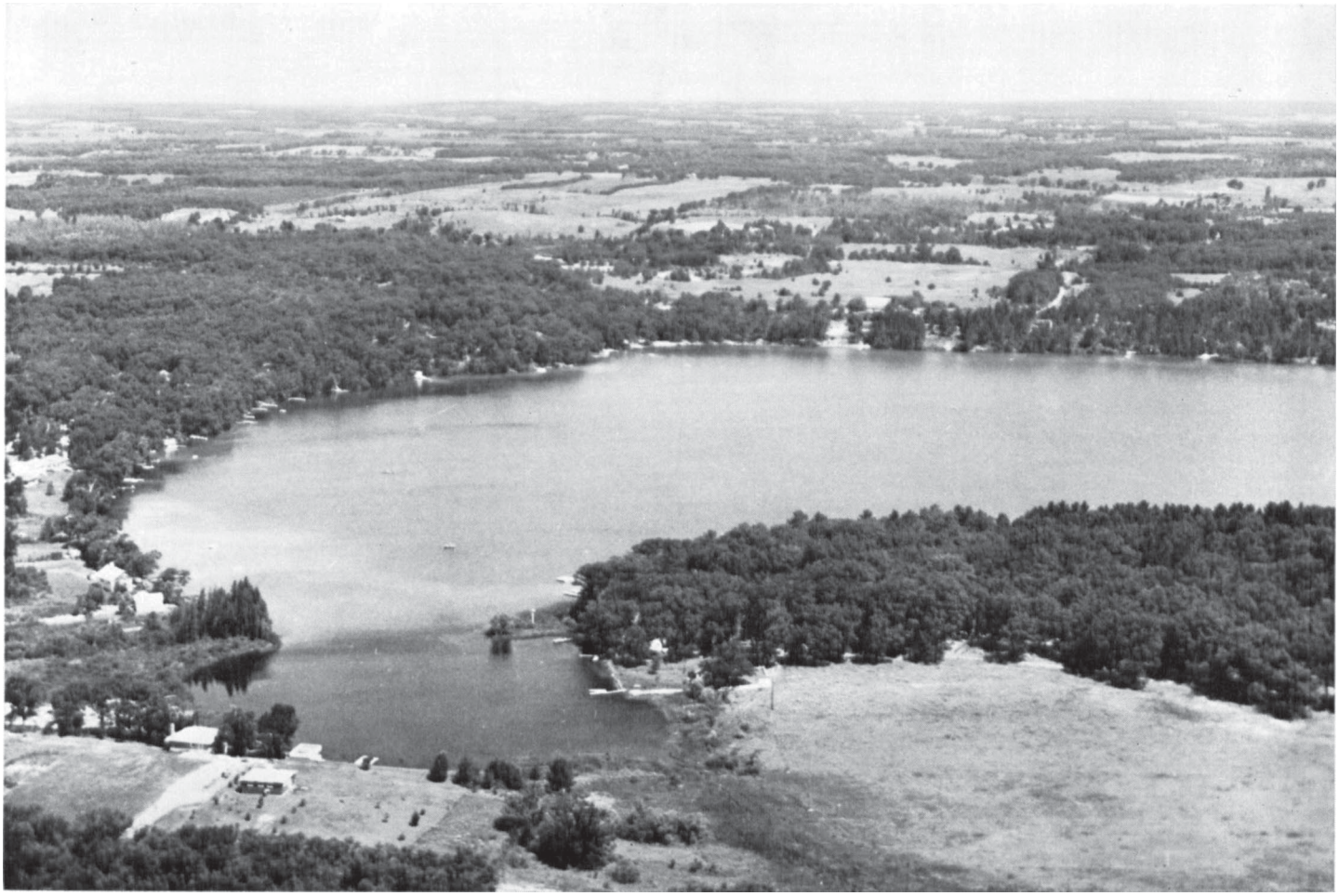

Figure 14.—**One of the many lakes that provide recreation for Marquette County. Its shores are sandy soils of the Boyer and Plainfield series.**

passed, and the towns settled down to a slow but steady pattern of development. At the time of the Civil War, many villages were approximately the same size as they are today. In recent years, however, the population has been declining. The total population of the county was 9,097 in 1940; 8,839 in 1950; 8,516 in 1960; and 8,865 in 1970.

Early in the history of the county, much of the transportation depended on the Fox River. In 1851, the first steamboat came up this river. In the 1870's, government dredges opened up the river to accommodate larger vessels, which carried both trade and passengers. Later, three railroad systems aided in the development of Marquette and surrounding counties. The first train came into the territory on August 8, 1857. Today, United States and State highways crisscross the county. In addition there are many roads that are well maintained by the county and townships.

Trucks now transport all the farm and industrial products to markets.

Farming is by far the most important enterprise in Marquette County. It employed 48.4 percent of the working people in the county in 1950. Trade allowed for 13.5 percent of the working force, and manufacturing about 10 percent of the labor force. About 12 manufacturing plants operate in the county. Among these are dairy and poultry processing plants, and plants that produce machine products, granite products (fig. 13), woodworking products, and leather products.

The many lakes and streams in the county provide attractions for outdoor sports (fig. 14). Approximately 40 resorts are in the county, and these provide for fishing, swimming, boating, hunting, camping, horseback riding, and other outdoor sports. Muir Park, a county park, offers camping grounds. The county has public hunting and fishing grounds.

Farming

Statistics in this section are from the U.S. Bureau of Census, U.S. Soil Conservation Service, Conservation Needs, and the Wisconsin State Department of Agriculture Crop and Livestock Reporting Service.

Among the types of farms in Marquette County are dairy, livestock other than dairy or poultry, cash grain, poultry, vegetable, and tree farms. The sizes of farms

vary considerably, but the average size farm was 209.7 acres in 1950, 224.5 acres in 1954, and 249.6 acres in 1969.

Corn is the most widely grown crop in Marquette County. Tame hay is second, and oats is third. Corn is grown in all soils suitable for row crops in the county. Oats have always been an important crop in the county. The average yield has been about 33 bushels per acre. Most of the oats are grown as a nurse crop for hay.

Most of the grain is ground and mixed with corn and protein concentrates and fed to livestock on the farm. The straw is stored and used for bedding.

Hay crops are grown extensively in the county. Some areas that are too steep for row crops are used primarily for hay. Alfalfa hay is by far the most widely grown hay crop in the county. The average yield of alfalfa is about 1.9 tons per acre. Alfalfa gives higher yields of good quality forage than other kinds of hay or pasture.

Rye is another important crop grown in the county. The average rye yield was 11.5 bushels per acre in 1956.

Marquette County has expanded rapidly in the production of specialty crops such as head lettuce, dry onions, mint, celery, and spinach. Most of these crops are grown on muck farms in the southern and eastern parts of the county. The number of muck farms increased from 2 in 1943 to about 15 in 1963. Growing these specialty crops is a highly intensified type of farming requiring large amounts of labor. The sandy areas of the county are suitable for growing cucumbers, and a comparatively large acreage is in cucumbers.

Nearly 29 percent of the acreage in farms in the county is in permanent pasture. Of this 29 percent, about 16 percent is woodland pastured and 13 percent is other land in permanent pasture. This permanent pasture consists of mostly native grasses. Many areas are so steep or stony that they cannot be renovated. Others provide little forage, but they can be improved by renovation.

In Marquette County livestock and livestock products provide the major part of the income derived from the sale of general farm products. Dairy cattle, beef cattle, and hogs are the most important of the animals raised.

The principal breed of dairy cattle raised in the county is Holstein, but also raised are other breeds such as Guernsey and Brown Swiss. Hereford and Aberdeen Angus are the most common breeds of beef cattle.

About 13,200 hogs are usually on farms in Marquette County. The number of sheep has declined somewhat in recent years. The county reported about 3,077 sheep and lambs in 1969.

Total egg production in the county has been fairly stable, but eggs laid per fowl has increased in recent years. This increase has been brought about through improved feeding and better management practices. Turkey production is becoming increasingly important.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. Classifications are very low, less than 3 inches; low, 3 to 6 inches; medium, 6 to 9 inches; high, 9 to 12 inches; and very high, more than 12 inches.

Cobblestone. A rounded or partly rounded fragment of rock, 3 to 10 inches in diameter.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A horizon and upper part of the B horizon and have mottling in the lower part of the B horizon and the C horizon.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be lacking or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Glacial drift (geology). Rock material transported by glacial ice and then deposited; also includes the assorted and unassorted materials deposited by streams flowing from glaciers.

Glacial outwash (geology). Crossbedded gravel, sand, and silt deposited by meltwater as it flowed from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gravelly soil material. From 15 to 50 percent of material by volume, consists of rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter.

Hemic material. Organic matter, in early stages of decay, derived from vegetation that grew on the soil.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed by lowering of the water level or elevation of the land.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical mineralogical, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

Muck. An organic soil consisting of fairly well decomposed organic material that is relatively high in mineral content, finely divided, and dark in color.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Peat. Unconsolidated soil material, largely undecomposed organic matter, that has accumulated where there has been excess moisture.

Pebble. A rounded or partly rounded fragment of rock, up to 3 inches in diameter.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Sapric material. Organic matter, at advanced stage of decay, derived mainly from vegetation that grew on the soil.

Stones. Rock fragments greater than 10 inches in diameter if rounded, and greater than 15 inches along the longer axis if flat.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which it belongs. In referring to a capability unit or woodland group, read the introduction to the section it is in for general information about its management. Other information is given in tables as follows:

Acreage and extent, table 1, p. 7.
Predicted yields, table 2, p. 47.
Recreation, table 3, p. 52.
Wildlife, tables 4 and 5, pp. 54 through 57.
Engineering, tables 6, 7, 8, and 9, pp. 60 through 81.

Map symbol	Mapping unit	Page	Capability unit		Woodland group		Recreation group	Wildlife group
			Symbol	Page	Number	Page	Number	Number
Ac	Adrian mucky peat, deep	6	IVw-7	45	10	51	1	6
Ad	Adrian mucky peat, shallow	6	IVw-7	45	10	51	1	6
Ae	Adrian mucky peat, deep, stratified subsoil variant	8	IVw-7	45	10	51	1	6
Ak	Adrian mucky peat, shallow, stratified subsoil variant	8	IVw-7	45	10	51	1	6
Am	Alluvial land	9	IIIw-12	44	9	51	5	7
An	Alluvial land, wet	9	IVw-5	45	9	51	3	5b
Ao	Ankeny fine sandy loam	9	IIIw-12	44	1	49	5	4
BmB	Boyer loamy fine sand, 2 to 6 percent slopes	10	IIIs-4	44	4	49	5	3
BmC2	Boyer loamy fine sand, 6 to 12 percent slopes, eroded	10	IIIe-7	44	4	49	5	3
BmD2	Boyer loamy fine sand, 12 to 20 percent slopes, eroded	10	IVe-7	44	4	49	5	3
BmE2	Boyer loamy fine sand, 20 to 30 percent slopes, eroded	10	VIIe-4	45	4	49	5	3
BnB	Boyer fine sandy loam, 2 to 6 percent slopes	10	IIIs-4	44	3	49	5	1
BnC2	Boyer fine sandy loam, 6 to 12 percent slopes, eroded	10	IIIe-7	44	3	49	5	1
BnD2	Boyer fine sandy loam, 12 to 20 percent slopes, eroded	10	IVe-7	44	3	49	5	1
BoA	Boyer fine sandy loam, dark surface variant, 0 to 2 percent slopes	12	IIIs-4	44	12	51	5	4
BoB	Boyer fine sandy loam, dark surface variant, 2 to 6 percent slopes	12	IIIs-4	44	12	51	5	4
BoC2	Boyer fine sandy loam, dark surface variant, 6 to 12 percent slopes, eroded	12	IIIe-7	44	12	51	5	4
BrB	Boyer-Oshtemo loamy sands, 2 to 6 percent slopes	11	IIIs-4	44	4	49	5	3
BrC2	Boyer-Oshtemo loamy sands, 6 to 12 percent slopes, eroded	11	IIIe-7	44	4	49	5	3
BsA	Briggsville loam, 0 to 2 percent slopes	13	IIs-7	43	1	49	6	2
BsB	Briggsville loam, 2 to 6 percent slopes	13	IIe-6	42	1	49	6	2
BsC2	Briggsville loam, 6 to 12 percent slopes, eroded	13	IIIe-2	43	1	49	6	2
BsD2	Briggsville loam, 12 to 20 percent slopes, eroded	13	IIIe-2	43	1	49	6	2
BvA	Briggsville silt loam, 0 to 2 percent slopes	13	IIs-7	43	1	49	6	2
BvB	Briggsville silt loam, 2 to 6 percent slopes	14	IIe-6	42	1	49	6	2
CaB	Casco fine sandy loam, 2 to 6 percent slopes	14	IIIe-4	43	5	50	5	3
CaC2	Casco fine sandy loam, 6 to 12 percent slopes, eroded	14	IVe-4	44	5	50	5	3
CaD2	Casco fine sandy loam, 12 to 20 percent slopes, eroded	14	VIe-4	45	5	50	5	3
CaE2	Casco fine sandy loam, 20 to 30 percent slopes, eroded	14	VIIe-4	45	5	50	5	3

Map symbol	Mapping unit	Page	Capability unit		Woodland group		Recreation group	Wildlife group
			Symbol	Page	Number	Page	Number	Number
Co	Colwood fine sandy loam	16	IIw-1	42	7	50	3	5b
DeB	Delton loamy fine sand, 1 to 6 percent slopes	16	IIIe-4	43	3	49	5	1
DeC2	Delton loamy fine sand, 6 to 12 percent slopes, eroded	16	IVe-4	44	3	49	5	1
DfA	Delton fine sandy loam, 0 to 2 percent slopes	16	IIIs-2	44	1	49	5	1
DfB	Delton fine sandy loam, 2 to 6 percent slopes	17	IIIe-4	43	1	49	5	1
DfC2	Delton fine sandy loam, 6 to 12 percent slopes, eroded	17	IVe-4	44	1	49	5	1
FmB	Fox sandy loam, 2 to 6 percent slopes	17	IIIs-4	44	1	49	2	1
FmC2	Fox sandy loam, 6 to 12 percent slopes, eroded	17	IIIe-7	44	1	49	2	1
FoB	Fox loam, 2 to 6 percent slopes	18	IIe-2	42	1	49	2	1
FoC2	Fox loam, 6 to 12 percent slopes, eroded	18	IIIe-2	43	1	49	2	1
GlA	Gotham loamy fine sand, 0 to 2 percent slopes	18	IVs-3	45	4	49	5	3
GlB	Gotham loamy fine sand, 2 to 6 percent slopes	18	IVs-3	45	4	49	5	3
GlC	Gotham loamy fine sand, 6 to 12 percent slopes	19	IVs-3	45	4	49	5	3
GlD	Gotham loamy fine sand, 12 to 20 percent slopes	19	VIe-4	45	4	49	5	3
GmA	Gotham loamy fine sand, loamy substratum, 0 to 2 percent slopes	19	IVs-3	45	4	49	5	3
GmB	Gotham loamy fine sand, loamy substratum, 2 to 6 percent slopes	19	IVs-3	45	4	49	5	3
GmC2	Gotham loamy fine sand, loamy substratum, 6 to 12 percent slopes, eroded	19	IVs-3	45	4	49	5	3
GmD2	Gotham loamy fine sand, loamy substratum, 12 to 20 percent slopes, eroded	19	VIe-4	45	4	49	5	3
GnA	Gotham fine sandy loam, 0 to 2 percent slopes	19	IVs-3	45	3	49	5	1
GnB	Gotham fine sandy loam, 2 to 6 percent slopes	20	IVs-3	45	3	49	5	1
GoA	Gotham fine sandy loam, loamy substratum, 1 to 3 percent slopes	20	IVs-3	45	3	49	5	1
Gr	Granby loamy fine sand	20	IVw-5	45	8	51	3	5b
Gs	Granby fine sandy loam	20	IVw-5	45	8	51	3	5b
Gt	Granby fine sandy loam, loamy substratum	20	IVw-5	45	8	51	3	5b
Hm	Houghton mucky peat	21	IIIw-9	44	10	51	1	6
Hp	Houghton peat, acid variant	21	VIIw-10	46	10	51	1	6
Ke	Keowns fine sandy loam	22	IVw-5	45	7	50	3	5b
LpB	Lapeer-Pardeeville fine sandy loams, 2 to 6 percent slopes	22	IIIe-4	43	1	49	2	1
LpC2	Lapeer-Pardeeville fine sandy loams, 6 to 12 percent slopes, eroded	22	IVe-4	44	1	49	2	1
LpD2	Lapeer-Pardeeville fine sandy loams, 12 to 20 percent slopes, eroded	23	VIe-4	45	1	49	2	1
LpE2	Lapeer-Pardeeville fine sandy loams, 20 to 30 percent slopes, eroded	23	VIIe-4	45	1	49	2	1
LrA	Lorenzo loam, 0 to 2 percent slopes	23	IIIs-4	44	12	51	2	4
LrB	Lorenzo loam, 2 to 6 percent slopes	23	IIIe-4	43	12	51	2	4
Ma	Marsh	24	VIIIw-15	46	11	51	1	5b
McD2	Mecan loamy fine sand, 12 to 20 percent slopes, eroded	24	VIe-4	45	3	49	5	3
McE2	Mecan loamy fine sand, 20 to 30 percent slopes, eroded	25	VIIe-4	45	3	49	5	3

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit		Woodland group		Recreation group	Wildlife group
			Symbol	Page	Number	Page	Number	Number
MeB	Mecan fine sandy loam, 2 to 6 percent slopes	25	IIIe-4	43	3	49	5	1
MeC2	Mecan fine sandy loam, 6 to 12 percent slopes, eroded	25	IVe-4	44	3	49	5	1
MfB	Metea loamy fine sand, 2 to 6 percent slopes	25	IIe-7	42	4	49	5	3
MfC2	Metea loamy fine sand, 6 to 12 percent slopes, eroded	25	IIIe-7	44	4	49	5	3
MfD	Metea loamy fine sand, 12 to 20 percent slopes	26	IVe-7	44	4	49	5	3
MlB	Metea loamy fine sand, sandy substratum, 2 to 6 percent slopes	26	IIe-7	42	4	49	5	3
MlC2	Metea loamy fine sand, sandy substratum, 6 to 12 percent slopes, eroded	26	IIIe-7	44	4	49	5	3
MmB	Metea fine sandy loam, 2 to 6 percent slopes	26	IIe-7	42	3	49	5	1
MmC	Metea fine sandy loam, 6 to 12 percent slopes	26	IIIe-7	44	3	49	5	1
MmD2	Metea fine sandy loam, 12 to 20 percent slopes, eroded	26	IVe-7	44	3	49	5	1
MnB	Metea fine sandy loam, sandy substratum, 2 to 6 percent slopes	26	IIe-7	42	3	49	5	1
MnC2	Metea fine sandy loam, sandy substratum, 6 to 12 percent slopes, eroded	27	IIIe-7	44	3	49	5	1
MoA	Metea fine sandy loam, stratified substratum, 0 to 2 percent slopes	27	IIs-7	43	3	49	5	1
MoB	Metea fine sandy loam, stratified substratum, 2 to 6 percent slopes	27	IIe-7	42	3	49	5	1
MoC	Metea fine sandy loam, stratified substratum, 6 to 12 percent slopes	27	IIIe-7	44	3	49	5	1
MrA	Montello loam, 0 to 2 percent slopes	28	IIs-7	43	12	51	6	2
MrB	Montello loam, 2 to 6 percent slopes	28	IIe-6	42	12	51	6	2
MsA	Montello silt loam, 0 to 2 percent slopes	28	IIs-7	43	12	51	6	2
MsB	Montello silt loam, 2 to 6 percent slopes	28	IIe-6	42	12	51	6	2
MtA	Mosel fine sandy loam, 0 to 3 percent slopes	29	IIw-2	43	7	50	4	5a
MuA	Mosel loam, 0 to 3 percent slopes	29	IIw-2	43	7	50	4	5a
MvA	Moundville loamy fine sand, 0 to 3 percent slopes	29	IVs-3	45	4	49	5	3
MwA	Moundville fine sandy loam, 0 to 3 percent slopes	29	IVs-3	45	3	49	5	3
MxA	Mundelein loam, 0 to 3 percent slopes	30	IIw-2	43	7	49	4	5a
MyA	Mundelein silt loam, 0 to 3 percent slopes	30	IIw-2	43	7	49	4	5a
OsA	Oshtemo loamy fine sand, 0 to 2 percent slopes	30	IIIs-4	44	4	49	5	3
OsB	Oshtemo loamy fine sand, 2 to 6 percent slopes	31	IIIs-4	44	4	49	5	3
OsC2	Oshtemo loamy fine sand, 6 to 12 percent slopes, eroded	31	IIIe-7	44	4	49	5	3
OsD2	Oshtemo loamy fine sand, 12 to 20 percent slopes, eroded	31	IVe-7	44	4	49	5	3
OtA	Oshtemo fine sandy loam, 0 to 2 percent slopes	31	IIIs-4	44	3	49	5	1
OtB	Oshtemo fine sandy loam, 2 to 6 percent slopes	31	IIIs-4	44	3	49	5	1
OtC2	Oshtemo fine sandy loam, 6 to 12 percent slopes, eroded	31	IIIe-7	44	3	49	5	1
Pa	Palms mucky peat, deep	32	IIw-8	43	10	51	1	6
Pc	Palms mucky peat, shallow	32	IIw-8	43	10	51	1	6

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit		Woodland group		Recreation group	Wildlife group
			Symbol	Page	Number	Page	Number	Number
PfC2	Plainfield sand, 0 to 12 percent slopes, eroded	33	VIs-3	45	4	49	5	3
PfD2	Plainfield sand, 12 to 20 percent slopes, eroded	33	VIIs-3	45	4	49	5	3
PlA	Plainfield loamy fine sand, 0 to 2 percent slopes	33	IVs-3	45	4	49	5	3
PlB	Plainfield loamy fine sand, 2 to 6 percent slopes	34	IVs-3	45	4	49	5	3
PlC	Plainfield loamy fine sand, 6 to 12 percent slopes	34	VIs-3	45	4	49	5	3
PlD2	Plainfield loamy fine sand, 12 to 20 percent slopes, eroded	34	VIIs-3	46	4	49	5	3
PnB	Plainfield-Wyocena complex, 2 to 6 percent slopes	34	IVs-3	45	4	49	5	3
PnC	Plainfield-Wyocena complex, 6 to 12 percent slopes	34	VIs-3	45	4	49	5	3
PnE	Plainfield-Wyocena complex, 12 to 30 percent slopes	34	VIIs-3	46	4	49	5	3
Po	Poygan fine sandy loam	35	IIw-1	42	7	50	3	5b
Ps	Poygan silty clay loam	35	IIw-1	42	7	50	3	5b
Ro	Rollin mucky peat	36	IVw-7	45	10	51	1	6
SeA	Seward fine sandy loam, 0 to 2 percent slopes	36	IIIs-2	44	1	49	5	1
SeB	Seward fine sandy loam, 2 to 6 percent slopes	36	IIIe-4	43	1	49	5	1
SoA	Sisson fine sandy loam, 0 to 2 percent slopes	37	I-4	42	1	49	5	1
SoB2	Sisson fine sandy loam, 2 to 6 percent slopes, eroded	37	IIe-2	42	1	49	5	1
SsA	Sisson loam, 0 to 2 percent slopes	37	I-4	42	1	49	5	1
SsB	Sisson loam, 2 to 6 percent slopes	37	IIe-2	42	1	49	5	1
StF	Steep sandy land	37	VIIs-9	46	4	49	5	3
TdA	Tedrow loamy fine sand, 0 to 3 percent slopes	38	IVw-5	45	8	51	4	5a
TeA	Tedrow loamy fine sand, loamy substratum, 0 to 3 percent slopes	38	IVw-5	45	8	51	4	5a
TfA	Tedrow fine sandy loam, 0 to 3 percent slopes	38	IVw-5	45	8	51	4	5a
TlA	Tedrow fine sandy loam, loamy substratum, 0 to 3 percent slopes	38	IVw-5	45	8	51	4	5a
WoB	Wyocena loamy fine sand, 2 to 6 percent slopes	39	IIIe-4	43	4	49	5	3
WoC	Wyocena loamy fine sand, 6 to 12 percent slopes	39	IVe-4	44	4	49	5	3
WoD	Wyocena loamy fine sand, 12 to 20 percent slopes	39	VIe-4	45	4	49	5	3
WoE	Wyocena loamy fine sand, 20 to 30 percent slopes	39	VIIe-4	45	4	49	5	3
WyB	Wyocena fine sandy loam, 2 to 6 percent slopes	39	IIIe-4	43	3	49	5	1
WyC2	Wyocena fine sandy loam, 6 to 12 percent slopes, eroded	39	IVe-4	44	3	49	5	1
YaA	Yahara fine sandy loam, 0 to 3 percent slopes	40	IIw-4	43	12	51	4	5a

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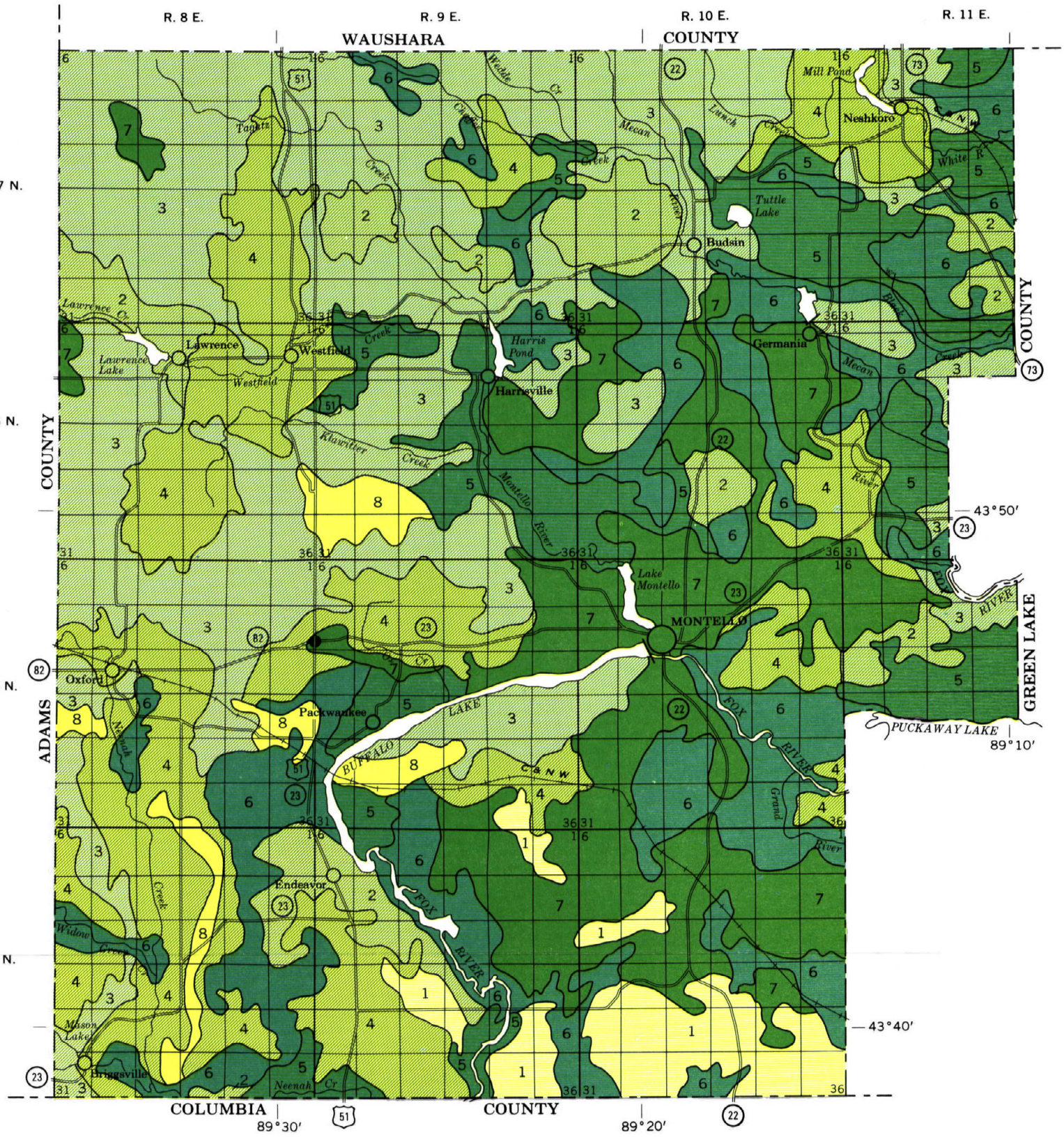


SOIL ASSOCIATIONS

1. Lapeer-Pardeeville-Metea association: Deep, well-drained, moderately permeable and moderately rapidly permeable soils that have a sandy clay loam, sandy loam, and loamy sand subsoil over loamy glacial till
2. Gotham-Mecan association: Deep, well-drained, moderately rapidly permeable and rapidly permeable soils that have a sandy loam and loamy fine sand subsoil over loamy glacial till and sandy outwash
3. Plainfield-Gotham association: Deep, excessively drained and well-drained, very rapidly permeable and rapidly permeable soils that have a sand substratum or a loamy fine sand subsoil over sandy outwash
4. Delton-Briggsville-Mundelein association: Deep, well-drained and somewhat poorly drained, slowly permeable and moderately slowly permeable soils that have a silty clay and silty clay loam subsoil over lake-laid silt, clay, or sand
5. Granby-Tedrow-Moundville association: Deep, poorly drained, somewhat poorly drained, and moderately well drained, rapidly permeable soils that have a loamy fine sand subsoil over sandy outwash
6. Houghton-Adrian association: Deep, very poorly drained, moderately rapidly permeable soils that have an organic subsoil over organic material or sand
7. Oshtemo-Gotham association: Deep, well-drained, moderately rapidly permeable and rapidly permeable soils that have a sandy loam and loamy fine sand subsoil over sandy outwash
8. Mecan-Metea association: Deep, well-drained, moderately permeable and moderately rapidly permeable soils that have a sandy loam and sandy clay loam subsoil over loamy glacial till

Compiled 1973

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

WISCONSIN RESEARCH DIVISION
COLLEGE OF AGRICULTURE AND LIFE SCIENCES
UNIVERSITY OF WISCONSIN

GENERAL SOIL MAP

MARQUETTE COUNTY, WISCONSIN

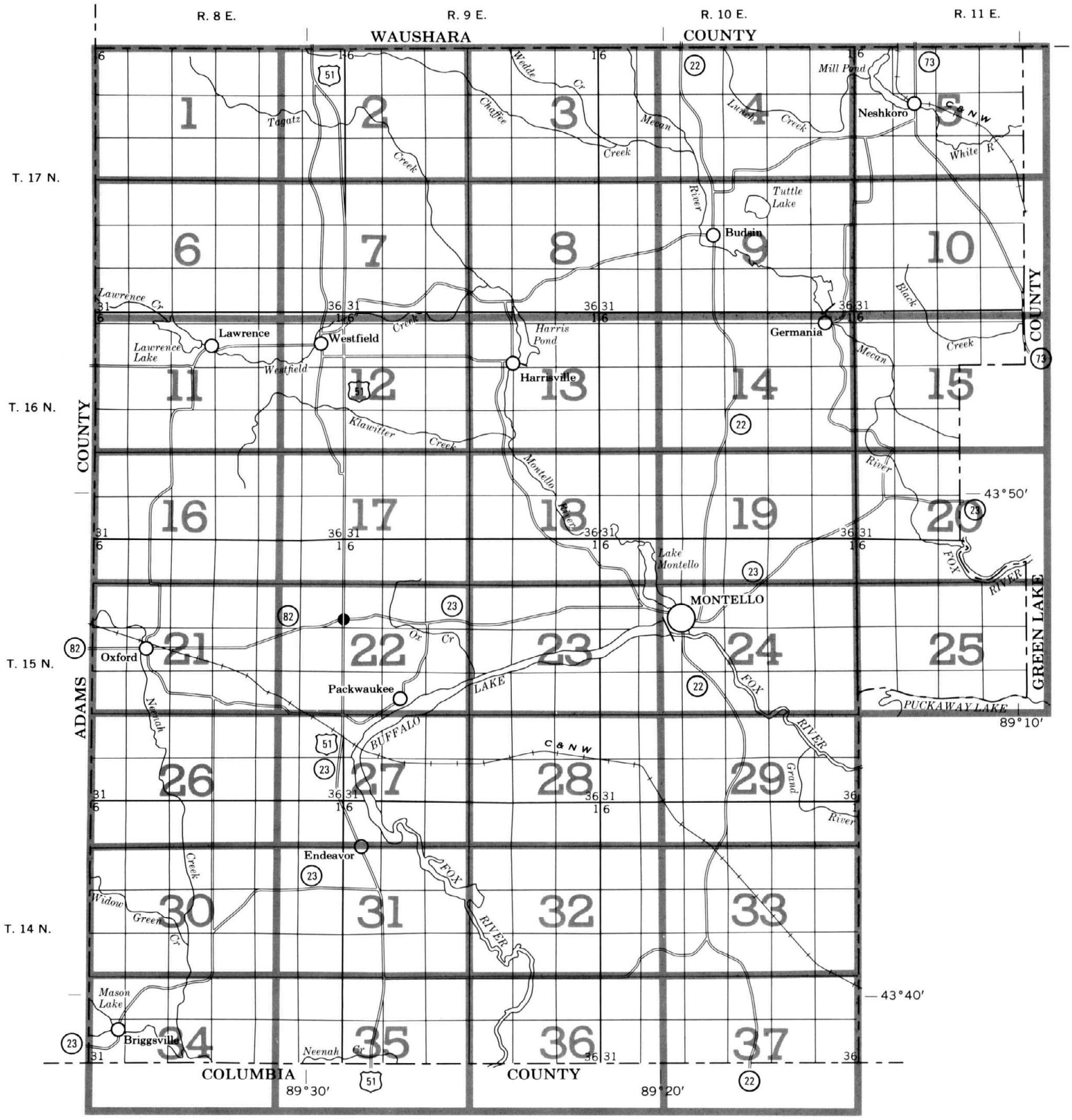
Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



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INDEX TO MAP SHEETS

MARQUETTE COUNTY, WISCONSIN

Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F, shows the slope. Symbols without a slope letter are those of nearly level soils. A final number, 2, in a symbol shows that the soil is named as eroded.

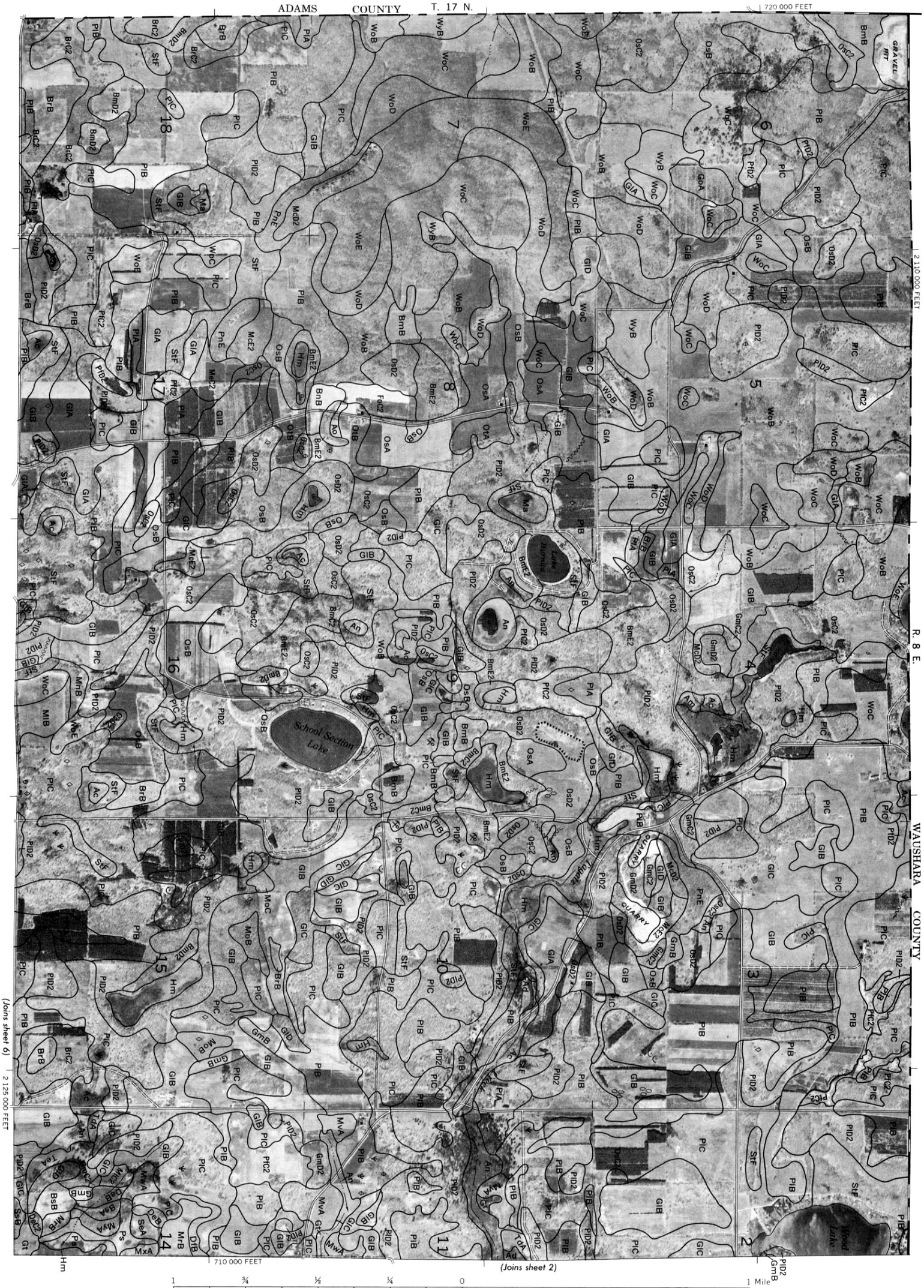
SYMBOL	NAME
Ac	Adrian mucky peat, deep
Ad	Adrian mucky peat, shallow
Ae	Adrian mucky peat, deep, stratified subsoil variant
Ak	Adrian mucky peat, shallow, stratified subsoil variant
Am	Alluvial land
An	Alluvial land, wet
Ao	Ankeny fine sandy loam
BmB	Boyer loamy fine sand, 2 to 6 percent slopes
BmC2	Boyer loamy fine sand, 6 to 12 percent slopes, eroded
BmD2	Boyer loamy fine sand, 12 to 20 percent slopes, eroded
BmE2	Boyer loamy fine sand, 20 to 30 percent slopes, eroded
BnB	Boyer fine sandy loam, 2 to 6 percent slopes
BnC2	Boyer fine sandy loam, 6 to 12 percent slopes, eroded
BnD2	Boyer fine sandy loam, 12 to 20 percent slopes, eroded
BoA	Boyer fine sandy loam, dark surface variant, 0 to 2 percent slopes
BoB	Boyer fine sandy loam, dark surface variant, 2 to 6 percent slopes
BoC2	Boyer fine sandy loam, dark surface variant, 6 to 12 percent slopes, eroded
BrB	Boyer-Oshtemo loamy sands, 2 to 6 percent slopes
BrC2	Boyer-Oshtemo loamy sands, 6 to 12 percent slopes, eroded
BsA	Briggsville loam, 0 to 2 percent slopes
BsB	Briggsville loam, 2 to 6 percent slopes
BsC2	Briggsville loam, 6 to 12 percent slopes, eroded
BsD2	Briggsville loam, 12 to 20 percent slopes, eroded
BvA	Briggsville silt loam, 0 to 2 percent slopes
BvB	Briggsville silt loam, 2 to 6 percent slopes
CaB	Casco fine sandy loam, 2 to 6 percent slopes
CaC2	Casco fine sandy loam, 6 to 12 percent slopes, eroded
CaD2	Casco fine sandy loam, 12 to 20 percent slopes, eroded
CaE2	Casco fine sandy loam, 20 to 30 percent slopes, eroded
Co	Colwood fine sandy loam
DeB	Delton loamy fine sand, 1 to 6 percent slopes
DeC2	Delton loamy fine sand, 6 to 12 percent slopes, eroded
DfA	Delton fine sandy loam, 0 to 2 percent slopes
DfB	Delton fine sandy loam, 2 to 6 percent slopes
DfC2	Delton fine sandy loam, 6 to 12 percent slopes, eroded
FmB	Fox sandy loam, 2 to 6 percent slopes
FmC2	Fox sandy loam, 6 to 12 percent slopes, eroded
FoB	Fox loam, 2 to 6 percent slopes
FoC2	Fox loam, 6 to 12 percent slopes, eroded
GlA	Gotham loamy fine sand, 0 to 2 percent slopes
GlB	Gotham loamy fine sand, 2 to 6 percent slopes
GlC	Gotham loamy fine sand, 6 to 12 percent slopes
GlD	Gotham loamy fine sand, 12 to 20 percent slopes
GmA	Gotham loamy fine sand, loamy substratum, 0 to 2 percent slopes
GmB	Gotham loamy fine sand, loamy substratum, 2 to 6 percent slopes
GmC2	Gotham loamy fine sand, loamy substratum, 6 to 12 percent slopes, eroded
GmD2	Gotham loamy fine sand, loamy substratum, 12 to 20 percent slopes, eroded
GnA	Gotham fine sandy loam, 0 to 2 percent slopes
GnB	Gotham fine sandy loam, 2 to 6 percent slopes
GoA	Gotham fine sandy loam, loamy substratum, 1 to 3 percent slopes
Gr	Granby loamy fine sand
Gs	Granby fine sandy loam
Gt	Granby fine sandy loam, loamy substratum
Hm	Houghton mucky peat
Hp	Houghton peat, acid variant
Ke	Keowns fine sandy loam
LpB	Lapeer-Pardeeville fine sandy loams, 2 to 6 percent slopes
LpC2	Lapeer-Pardeeville fine sandy loams, 6 to 12 percent slopes, eroded
LpD2	Lapeer-Pardeeville fine sandy loams, 12 to 20 percent slopes, eroded
LpE2	Lapeer-Pardeeville fine sandy loams, 20 to 30 percent slopes, eroded
LrA	Lorenzo loam, 0 to 2 percent slopes
LrB	Lorenzo loam, 2 to 6 percent slopes
Ma	Marsh
McD2	Mecan loamy fine sand, 12 to 20 percent slopes, eroded
McE2	Mecan loamy fine sand, 20 to 30 percent slopes, eroded
MeB	Mecan fine sandy loam, 2 to 6 percent slopes
MeC2	Mecan fine sandy loam, 6 to 12 percent slopes, eroded
MfB	Metea loamy fine sand, 2 to 6 percent slopes
MfC2	Metea loamy fine sand, 6 to 12 percent slopes, eroded
MfD	Metea loamy fine sand, 12 to 20 percent slopes
MlB	Metea loamy fine sand, sandy substratum, 2 to 6 percent slopes
MlC2	Metea loamy fine sand, sandy substratum, 6 to 12 percent slopes, eroded
MmB	Metea fine sandy loam, 2 to 6 percent slopes
MmC	Metea fine sandy loam, 6 to 12 percent slopes
MmD2	Metea fine sandy loam, 12 to 20 percent slopes, eroded
MnB	Metea fine sandy loam, sandy substratum, 2 to 6 percent slopes
MnC2	Metea fine sandy loam, sandy substratum, 6 to 12 percent slopes, eroded
MoA	Metea fine sandy loam, stratified substratum, 0 to 2 percent slopes
MoB	Metea fine sandy loam, stratified substratum, 2 to 6 percent slopes
MoC	Metea fine sandy loam, stratified substratum, 6 to 12 percent slopes
MrA	Montello loam, 0 to 2 percent slopes
MrB	Montello loam, 2 to 6 percent slopes
MsA	Montello silt loam, 0 to 2 percent slopes
MsB	Montello silt loam, 2 to 6 percent slopes
MtA	Mosel fine sandy loam, 0 to 3 percent slopes
MuA	Mosel loam, 0 to 3 percent slopes
MvA	Moundville loamy fine sand, 0 to 3 percent slopes
MwA	Moundville fine sandy loam, 0 to 3 percent slopes
MxA	Mundelein loam, 0 to 3 percent slopes
MyA	Mundelein silt loam, 0 to 3 percent slopes
OsA	Oshtemo loamy fine sand, 0 to 2 percent slopes
OsB	Oshtemo loamy fine sand, 2 to 6 percent slopes
OsC2	Oshtemo loamy fine sand, 6 to 12 percent slopes, eroded
OsD2	Oshtemo loamy fine sand, 12 to 20 percent slopes, eroded
OtA	Oshtemo fine sandy loam, 0 to 2 percent slopes
OtB	Oshtemo fine sandy loam, 2 to 6 percent slopes
OtC2	Oshtemo fine sandy loam, 6 to 12 percent slopes, eroded
Pa	Palms mucky peat, deep
Pc	Palms mucky peat, shallow
PfC2	Plainfield sand, 0 to 12 percent slopes, eroded
PfD2	Plainfield sand, 12 to 20 percent slopes, eroded
PlA	Plainfield loamy fine sand, 0 to 2 percent slopes
PlB	Plainfield loamy fine sand, 2 to 6 percent slopes
PlC	Plainfield loamy fine sand, 6 to 12 percent slopes
PlD2	Plainfield loamy fine sand, 12 to 20 percent slopes, eroded
PnB	Plainfield-Wyocena complex, 2 to 6 percent slopes
PnC	Plainfield-Wyocena complex, 6 to 12 percent slopes
PnE	Plainfield-Wyocena complex, 12 to 30 percent slopes
Po	Poygan fine sandy loam
Ps	Poygan silty clay loam
Ro	Rollin mucky peat
SeA	Seward fine sandy loam, 0 to 2 percent slopes
SeB	Seward fine sandy loam, 2 to 6 percent slopes
SoA	Sisson fine sandy loam, 0 to 2 percent slopes
SoB2	Sisson fine sandy loam, 2 to 6 percent slopes, eroded
SsA	Sisson loam, 0 to 2 percent slopes
SsB	Sisson loam, 2 to 6 percent slopes
StF	Steep sandy land
TdA	Tedrow loamy fine sand, 0 to 3 percent slopes
TeA	Tedrow loamy fine sand, loamy substratum, 0 to 3 percent slopes
TfA	Tedrow fine sandy loam, 0 to 3 percent slopes
TlA	Tedrow fine sandy loam, loamy substratum, 0 to 3 percent slopes
WoB	Wyocena loamy fine sand, 2 to 6 percent slopes
WoC	Wyocena loamy fine sand, 6 to 12 percent slopes
WoD	Wyocena loamy fine sand, 12 to 20 percent slopes
WoE	Wyocena loamy fine sand, 20 to 30 percent slopes
WyB	Wyocena fine sandy loam, 2 to 6 percent slopes
WyC2	Wyocena fine sandy loam, 6 to 12 percent slopes, eroded
YaA	Yahara fine sandy loam, 0 to 3 percent slopes

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 1



MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 2

WAUSHARA COUNTY

R. 8 E. | R. 9 E.

2 150 000 FEET

720 000 FEET

T. 17 N.

(Joins sheet 1)

(Joins sheet 3)

(Joins sheet 7)

2 130 000 FEET

710 000 FEET

Springfield Corners

Scale 1:20000

1 Mile 5000 Feet

MARQUETTE COUNTY, WISCONSIN NO. 2

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 3

WAUSHARA COUNTY

R. 9 E. | R. 10 E.

T. 17 N.

2 155 000 FEET

720 000 FEET

710 000 FEET

2 170 000 FEET

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 8)

Lake Sharon

Crystal Lake

Wedde Creek

Chaffee Creek

Mecan River

Little Mecan River

Airstrip

N

Scale 1:20000

1 Mile

5000 Feet

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 3

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 4

MARQUETTE COUNTY, WISCONSIN NO 4

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 5

5

N

R. 11 E.

WAUSHARA COUNTY

GREEN LAKE COUNTY

T. 17 N.

2 200 000 FEET

720 000 FEET

710 000 FEET

2 220 000 FEET

Neshkoro

POND

WHITE RIVER

CHICAGO AND NORTH WESTERN

(Joins sheet 4)

(Joins sheet 10)

1 Mile

5000 Feet

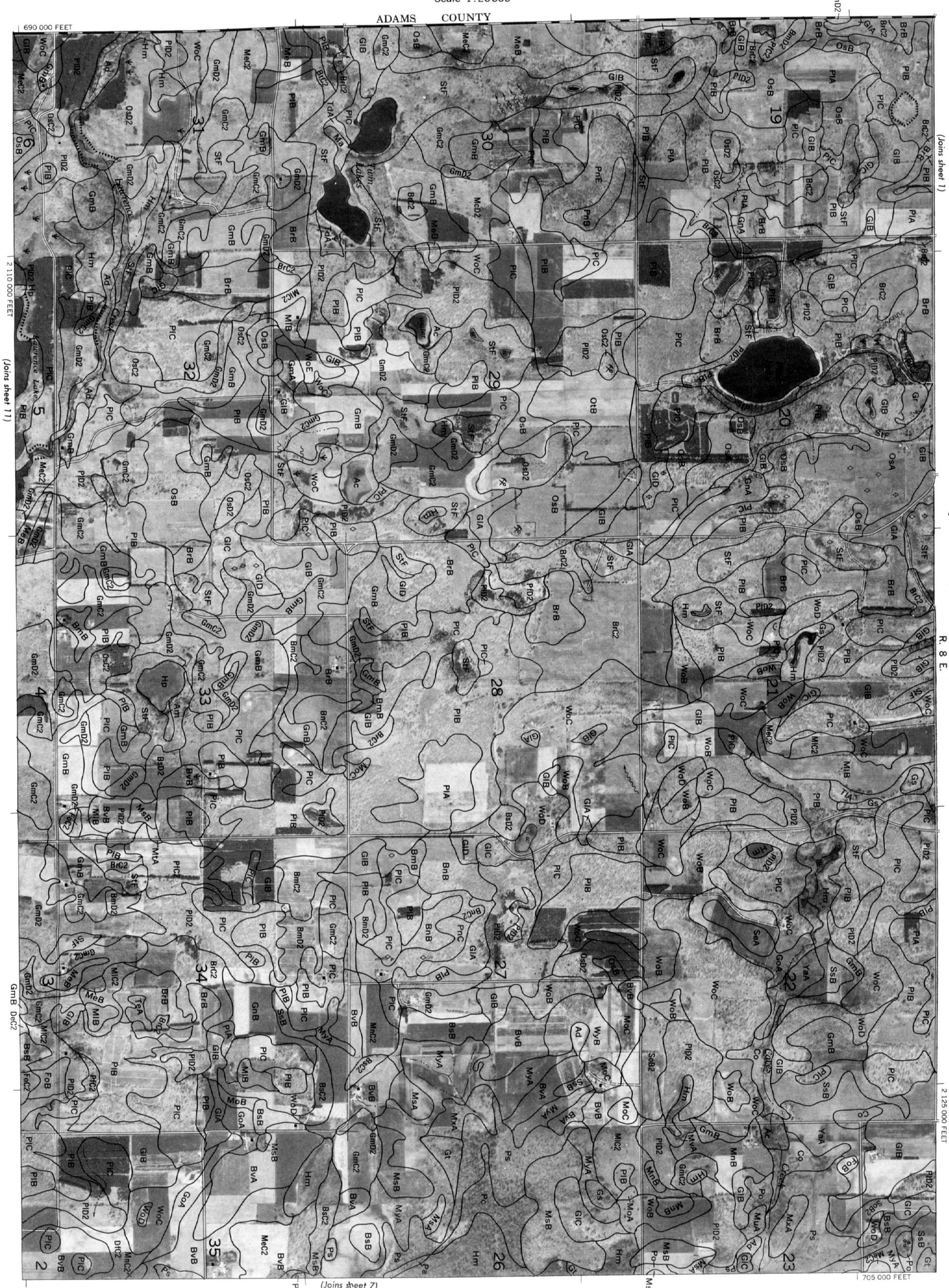
Scale 1:20000

MARQUETTE COUNTY, WISCONSIN NO. 5

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.



MARQUETTE COUNTY, WISCONSIN NO. 6

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 7

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 7

2 130 000 FEET

R. 8 E. | R. 9 E.

705 000 FEET

(Joins sheet 2)

(Joins sheet 6)

(Joins sheet 8)

(Joins sheet 12)

T.16 N. | T.17 N.

695 000 FEET

2 150 000 FEET

Westfield

Creek

7

N

1 Mile

5000 Feet

Scale 1:20000

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 8

8

N

R. 9 E. | R. 10 E.

2 170 000 FEET

705 000 FEET

695 000 FEET

2 155 000 FEET

T. 16 N. | T. 17 N.

(Joins sheet 3)

(Joins sheet 7)

(Joins sheet 9)

(Joins sheet 13)

Scale 1:20000

1 Mile 5000 Feet

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

MARQUETTE COUNTY, WISCONSIN NO. 8

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 9

9

N

R. 10 E.

2 175 000 FEET

705 000 FEET

(Joins sheet 4)

(Joins sheet 10)

(Joins sheet 8)

(Joins sheet 14)

695 000 FEET

2 195 000 FEET

T. 16 N. | T. 17 N.

Tilleda Lake

MECAN RIVER

Budsin

Scale 1:20000

1 Mile 0 5000 Feet

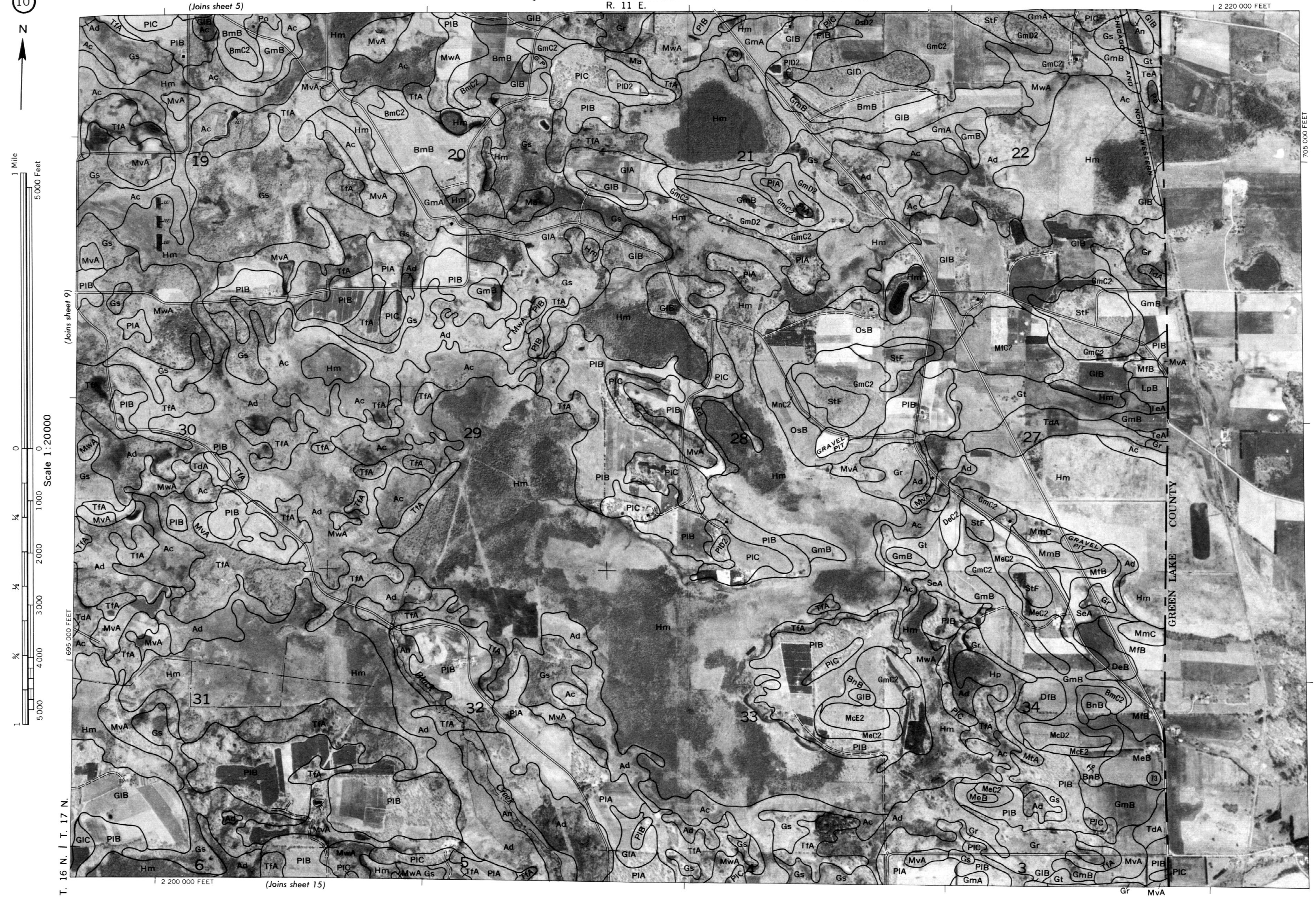
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO 9

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 10



MARQUETTE COUNTY, WISCONSIN NO. 10

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

11

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.
Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 11

N

Scale 1:20000

1 Mile
5000 Feet
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 12

(12)

N

(Joins sheet 7)

R. 8 E. | R. 9 E.

2 150 000 FEET

690 000 FEET

(Joins sheet 11)

T. 16 N.

(Joins sheet 13)

675 000 FEET

2 130 000 FEET

(Joins sheet 17)

Westfield

County Fairgrounds

Westfield Creek

Kinnickinnic River

1 Mile

5000 Feet

Scale 1:20000

0

1000 2000 3000 4000 5000

1 ¼ ½ ¾ 1

MARQUETTE COUNTY, WISCONSIN NO. 12

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

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MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 13

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 13

2 155 000 FEET

690 000 FEET

R. 9 E. | R. 10 E.

(Joins sheet 8)

T. 16 N.

(Joins sheet 12)

(Joins sheet 14)

(Joins sheet 18)

2 170 000 FEET

675 000 FEET

13

N

Scale 1:20000

1 Mile

5000 Feet

Harrisville

Silver Lake

Mud Lake

RIVER

MONTELLO

Klaustitel Creek

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 14

(14)

N

1 Mile

5 000 Feet

Scale 1:20000

0 ¼ ½ ¾ 1 0 1000 2000 3000 4000 5000

R. 10 E.

T. 16 N.

2 195 000 FEET

690 000 FEET

675 000 FEET

2 175 000 FEET

(Joins sheet 9)

(Joins sheet 13)

(Joins sheet 15)

(Joins sheet 19)

Cornstock Lake

Germania

MECAN RIVER

MARQUETTE COUNTY, WISCONSIN NO. 14

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

Land division corners are approximately positioned on this map.

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MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 15

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 15

2 200 000 FEET

690 000 FEET

R. 11 E.

(Joins sheet 10)

T. 16 N.

(Joins sheet 14)

(Joins sheet 20)

2 220 000 FEET

675 000 FEET

GREEN LAKE COUNTY

Black Creek

MEGAN RIVER

MILL

RACE

15

N

1 Mile

5000 Feet

Scale 1:20000

N

(Joins sheet 11)

R. 8 E.

2 125 000 FEET

670 000 FEET

(Joins sheet 17)

T. 15 N. | T. 16 N.

ADAMS COUNTY

2 110 000 FEET

(Joins sheet 21)

660 000 FEET

1 Mile

5000 Feet

Scale 1:20000

MARQUETTE COUNTY, WISCONSIN NO. 16

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 17

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.
Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 17

1 Mile
5000 Feet
Scale 1:20000
0 1000 2000 3000 4000 5000 FEET

MARQUETTE COUNTY, WISCONSIN NO. 18

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximately positioned on this map.
Land division corners are approximate and based on the Wisconsin coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 19

19

N

R. 10 E.

2 175 000 FEET

670 000 FEET

(Joins sheet 14)

(Joins sheet 18)

(Joins sheet 20)

(Joins sheet 24)

2 195 000 FEET

660 000 FEET

T. 15 N. | T. 16 N.

Mud Lake

White Lake

GRAVEL PIT

1 Mile

5000 Feet

Scale 1:20000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 19

MARQUETTE COUNTY, WISCONSIN NO. 20

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.
Land division corners are approximately positioned on this map.
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 21

21

N

R. 8 E.

(Joins sheet 16)

2 110 000 FEET

655 000 FEET

T. 15 N.

ADAMS COUNTY

(Joins sheet 22)

645 000 FEET

(Joins sheet 26)

2 125 000 FEET

Neenah Lake

Oxford Lake

Oxford

CHICAGO AND NORTH WESTERN

1 Mile

5000 Feet

Scale 1:20000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 21

1 Mile
5000 Feet
Scale 1:20000

MARQUETTE COUNTY, WISCONSIN NO. 22

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

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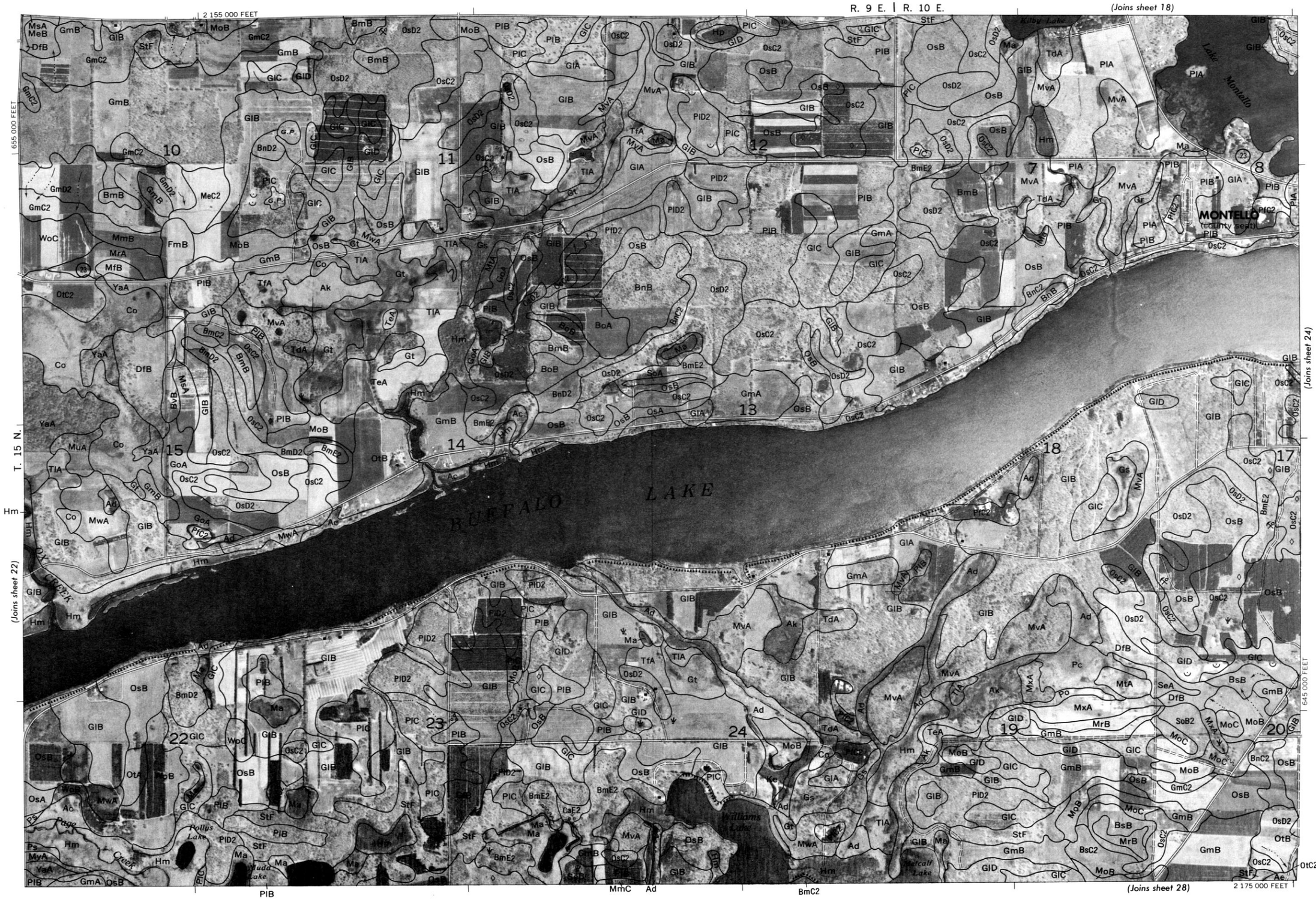
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.
Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 23



(24)

N

R. 10 E.

T. 15 N.

2 195 000 FEET

655 000 FEET

645 000 FEET

2 180 000 FEET

(Joins sheet 19)

(Joins sheet 23)

(Joins sheet 25)

(Joins sheet 29)

MONTELLO
(county seat)

White Lake

RIVER

water

1 Mile

5 000 Feet

Scale 1:20000

MARQUETTE COUNTY, WISCONSIN NO. 24

GREEN LAKE CO.

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

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MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 25

25

N

R. 11 E.

(Joins sheet 20)

T. 15 N.

(Joins sheet 24)

2 200 000 FEET

655 000 FEET

645 000 FEET

2 220 000 FEET

PUCKAWAY LAKE

GREEN LAKE COUNTY

Scale 1:20000

1 Mile 0 1/4 1/2 3/4 1

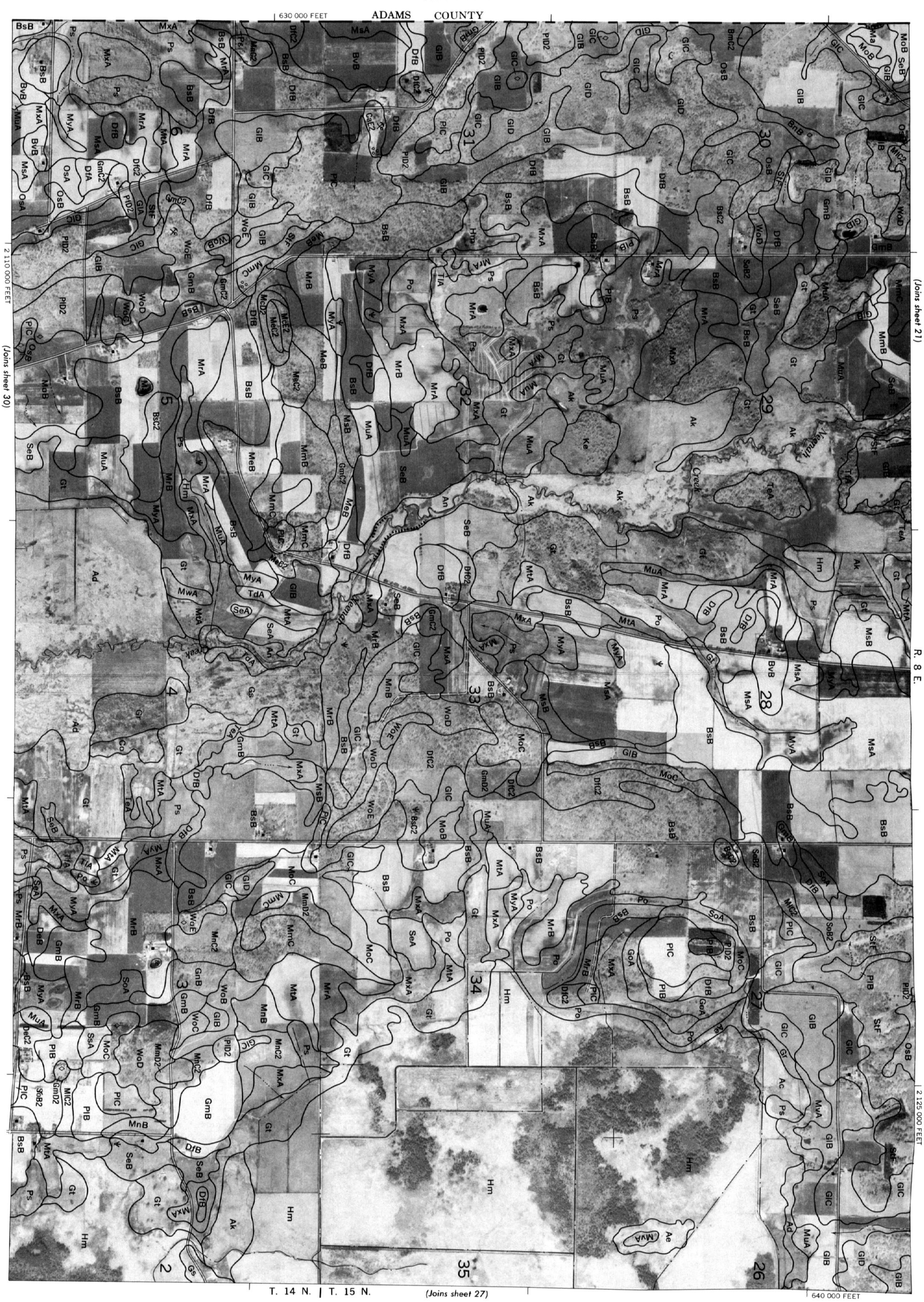
5000 Feet 0 1000 2000 3000 4000 5000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 25



MARQUETTE COUNTY, WISCONSIN NO. 26

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.
Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 27

R. 8 E. | R. 9 E.

T. 14 N. | T. 15 N.

2 130 000 FEET

640 000 FEET

630 000 FEET

2 150 000 FEET

(Joins sheet 22)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 31)

Buffalo Lake
Fox River
Chapman Creek
Chicago and North Western
Buffalo Shore Estates
Endeavor
Gravel Pit

N

Scale 1:20000

1 Mile
5 000 Feet

N

1 Mile 5000 Feet

0 0

Scale 1:20000

1 ¼ ½ ¾ 1000 2000 3000 4000 5000

(Joins sheet 23) R. 9 E. | R. 10 E. 2 175 000 FEET

640 000 FEET

630 000 FEET

T. 14 N. | T. 15 N.

(Joins sheet 27) (Joins sheet 29) (Joins sheet 32)

2 155 000 FEET

MARQUETTE COUNTY, WISCONSIN NO. 28

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximately positioned on this map.

Land division corners are approximate and based on the Wisconsin coordinate system, south zone.

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.
Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 29

29

N

R. 10 E.

2 180 000 FEET

640 000 FEET

(Joins sheet 24)

(Joins sheet 28)

T. 14 N. | T. 15 N.

GREEN LAKE COUNTY

630 000 FEET

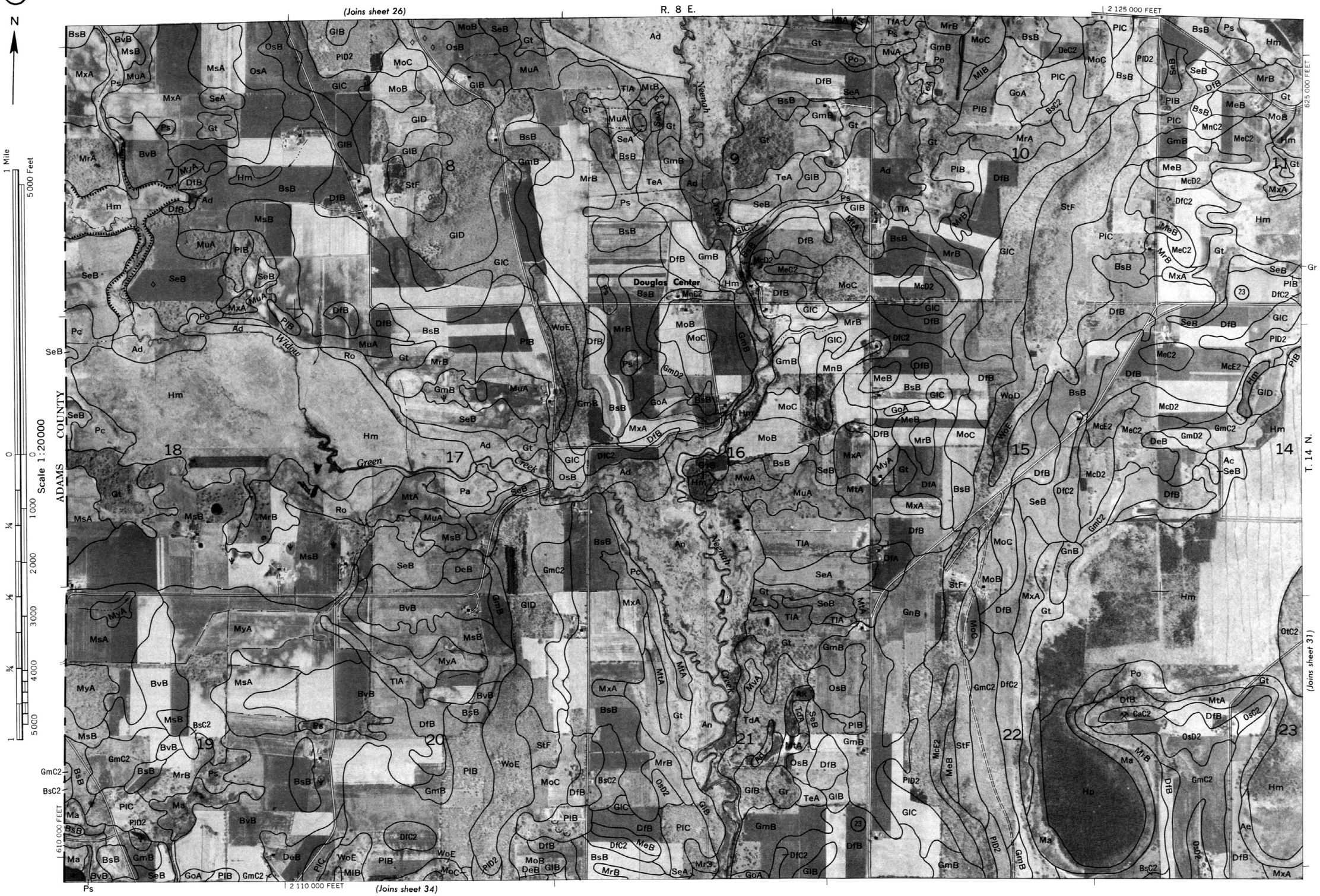
2 195 000 FEET

(Joins sheet 33)

1 Mile

5000 Feet

Scale 1:20000



MARQUETTE COUNTY, WISCONSIN NO. 30

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 31

31

N

R. 8 E. | R. 9 E.

T. 14 N.

2 130 000 FEET

625 000 FEET

610 000 FEET

2 150 000 FEET

(Joins sheet 27)

(Joins sheet 30)

(Joins sheet 32)

(Joins sheet 35)

Endeavor

FOX RIVER

Scale 1:20000

1 Mile

5000 Feet

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 31

N

(Joins sheet 28)

R. 9 E. | R. 10 E.

2 175 000 FEET

625 000 FEET

(Joins sheet 31)

1 Mile

5 000 Feet

0 0

Scale 1:20000

1 5000 ¾ 4000 ½ 3000 ¼ 2000 1000

610 000 FEET

2 155 000 FEET

(Joins sheet 36)

(Joins sheet 33)

T. 14 N.

MARQUETTE COUNTY, WISCONSIN NO. 32

Land division corners are approximately positioned on this map

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 33

33

MARQUETTE COUNTY, WISCONSIN NO. 33

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wisconsin Research Division of the College of Agriculture and Life Sciences, University of Wisconsin.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

Land division corners are approximately positioned on this map.

2 180 000 FEET

625 000 FEET

R. 10 E.

T. 14 N.

(Joins sheet 29)

(Joins sheet 32)

(Joins sheet 37)

2 195 000 FEET

615 000 FEET

Greenwood Church

Madden Lakes

Belle Fountain Creek

NORTH WESTERN

CHICAGO

GREEN LAKE COUNTY

N

Scale 1:20000

1 Mile

5000 Feet

MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 34

34

N

R. 8 E.

T. 14 N.

(Joins sheet 30)

(Joins sheet 35)

ADAMS COUNTY

COLUMBIA COUNTY

Mason Lake

Briggsville

Little Lake

SOUTH BRANCH NEENAH CREEK

Scale 1:20000

1 Mile 5000 Feet

2 125 000 FEET

605 000 FEET

595 000 FEET

2 110 000 FEET

MARQUETTE COUNTY, WISCONSIN NO. 34

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.
Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 35

35

N

2 130 000 FEET

R. 8 E. | R. 9 E.

605 000 FEET

T. 14 N.

595 000 FEET

2 150 000 FEET

(Joins sheet 34)

(Joins sheet 36)

BmC2 (Joins sheet 31)

COLUMBIA COUNTY

NEENAH CREEK

1 Mile 5 000 Feet

Scale 1:20000

0 0

1/4 1 000

1/2 2 000 3 000

3/4 4 000

1 5 000

N

R. 9 E. | R. 10 E.

T. 14 N.

MyA (Joins sheet 32)

(Joins sheet 35)

(Joins sheet 37)

COLUMBIA COUNTY

2 175 000 FEET

2 155 000 FEET

605 000 FEET

595 000 FEET

Scale 1:20000

1 Mile

5000 Feet

0 1000 2000 3000 4000 5000

MARQUETTE COUNTY, WISCONSIN NO. 36

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

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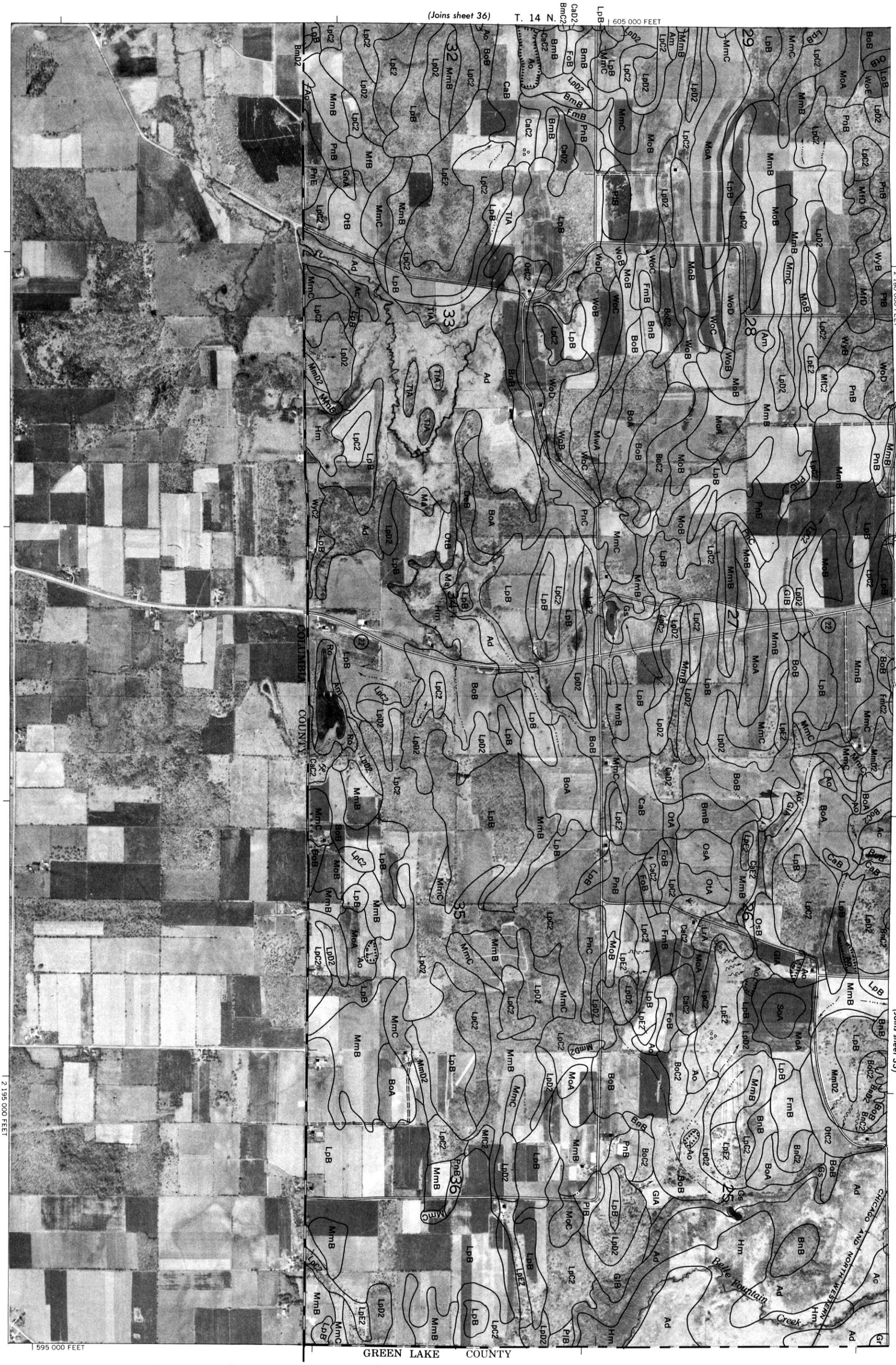
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wisconsin coordinate system, south zone.

Land division corners are approximately positioned on this map.

MARQUETTE COUNTY, WISCONSIN NO. 37



MARQUETTE COUNTY, WISCONSIN — SHEET NUMBER 37

MARQUETTE COUNTY, WISCONSIN

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads

- Divided
- Good motor
- Poor motor
- Trail

Highway markers

- National Interstate
- U. S.
- State or county

Railroads

- Single track
- Multiple track
- Abandoned

Bridges and crossings

- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

- Buildings
- School
- Church
- Mine and quarry
- Gravel pit
- Power line
- Pipeline
- Cemetery
- Dams
- Levee
- Tanks
- Well, oil or gas
- Forest fire or lookout station
- Windmill
- Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line

- Perennial
- Intermittent

Streams, single-line

- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

- Canals and ditches

Lakes and ponds

- Perennial (water, w)
- Intermittent (int)

- Spring
- Marsh or swamp
- Wet spot
- Drainage end or alluvial fan

RELIEF

Escarpments

- Bedrock
- Other

- Short steep slope
- Prominent peak

Depressions

	Large	Small
Crossable with tillage implements		
Not crossable with tillage implements		
Contains water most of the time		

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stoniness
  - Stony
  - Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully